December 1980
USA $2.95/DM 9.80

kilobaud

# MICROCOMPUTING T.M.

## Scroll Over, Beethoven

### Tune Up Your Micro for Music

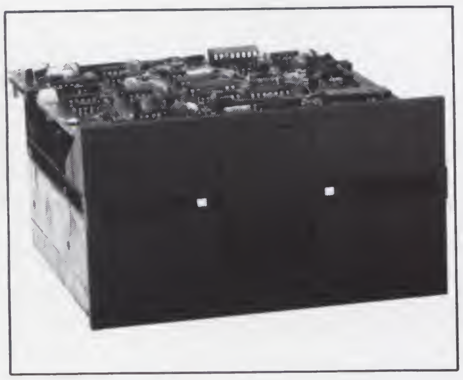
**Special Music/Sound Generation Issue**

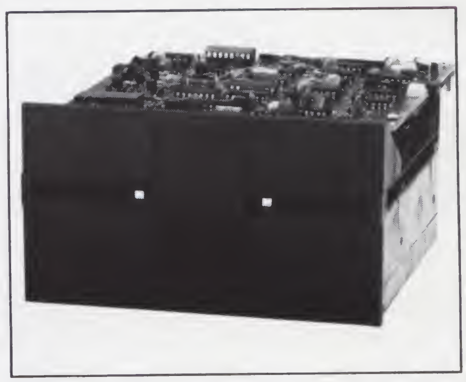
☐ ZX-80, Compucolor II and Imagination Machine Reviews ☐ Book Publishing with an Apple ☐ Connecting to The Source ☐ A Systems House Rides the Bumpy Rainbow ☐ Wine Making with the SWTP ☐ Software Reviews for North Star, Heath and CP/M

12
74470 65945

# GO FIRST CLASS

**½ MByte**
**TM-100-3 (Single-sided)**
Capacity (unformatted):
500K bytes
TPI: 96 or 100
Tracks per side:
80 maximum
Recording density:
5535 BPI
Access time:
• Track to track: 3ms
• Average: 90 ms





**1 MByte**
**TM-100-4 (Double-sided)**
Capacity (unformatted):
1,000K bytes
TPI: 96 or 100
Tracks per side:
160 maximum
Recording density:
5877 BPI
Access time:
• Track to track: 3 ms
• Average: 90 ms

# At an economy Price

It doesn't cost anymore to go first class when it's a Tandon 5¼" flexible disk drive. The reason is simple. We're the recognized leader in mini-floppy read/write head technology. In fact, our patented, double-sided head design is used by all the other major mini-floppy suppliers. And, it makes no difference if you buy one or one-thousand drives, you'll always get the first class price/performance that's made Tandon first choice among OEMs of word processing, small business systems, and personal computers. Tandon is rapidly becoming the first name in mini-floppies because we offer up to *one megabyte* of storage capacity, the fastest access time, a choice of single or double-sided recording, and 96 or 100 tracks per inch. All with proven reliability at an unbeatable price. Because we are the leaders in head technology, Tandon mini-floppies are designed beginning with the head to assure dependability throughout each drive. With Tandon, going first class is both sensible and economical.

✓318

**Tandon**

9333 Oso Ave.
Chatsworth, California 91311
(213) 993-6644

**Heads Above The Rest in Disk Technology**

# If you can type, you can handle your accounting, word processing and much more on ISC's Small Business Computer!

The Intecolor® 8963 is just one of a complete line of ISC desktop computers designed for businessmen who don't know how – or don't have time – to write programs. It's CP/M® compatible, so you can choose from hundreds of CP/M business programs – programs that have been proven in hundreds of actual applications.

Programs like General Ledger, Accounts Receivable and Payable, Payroll, Mailing List and Inventory Control are now available *in color.* You'll comprehend data faster, thanks to the proven readability of ISC's eight-color display.

To compose letters and other documents quickly and easily, you'll want ISC's unique *color-coded* Word Processing program. With an optional printer, you can print out as many mistake-free originals as you want!

The Intecolor 8963 gives you all the benefits of color graphics computing at a price that's competitive with black-and-white. It's complete with 19" color graphics display, typewriter-like keyboard, dual disk drive for data storage – even a color version of Microsoft® Business BASIC for those of you who *do* want to program.

Don't let your business get behind the times. Call your ISC sales representative or visit your nearest Factory Authorized ISC dealer and get a "hands on" demonstration *today.*

**Color Communicates Better℠**

* U S domestic price Unretouched photo of screen. CP M is a registered trademark of Digital Research Corp

OEM Quantity Discounts are available to Qualified Dealers and Volume Users of 25 Systems (or greater) per year. Call your nearest ISC Representative listed below.

**ISC SALES REPRESENTATIVES: AL:** 205 883-8660. **AZ:** 602 994-5400. **AR:** (OK) USDATA Assoc 918 252-9646. **CA:** Alhambra 213 281-2280. Goleta 805 964-8751. Irvine 714 557-4460. Los Angeles 213/476-1241. Los Altos 415 948-4563. San Diego 714 292-8525. **CO:** 303 355-2363. **CT:** 203/624-7800. **DE:** (PA) 215 542-9876. **DC:** (VA) 703 569-1502. **FL:** Ft Lauderdale 305 776-4800. Melbourne 305 723-0766. Orlando 305 425-5505. Tallahassee 904 878-6642. **GA:** Atlanta 404 455-1035. **HI:** 808 524-8633. **ID:** (UT) 801 292-8145. **IL:** (No.) 312 564-5440. (So MO) 816 765-3337. **IN:** (IL) 312/564-5440. **IA:** (Scott County Only) 312 564-5440. (MO) 816 765-3337. **KS:** (MO) 816 765-3337. **KY:** 606 273-3771. **LA:** 504 626-9701. **ME:** (MA) 617 729-5770. **MD:** (VA) 703 569-1502. **MA:** 617 729-5770. **MI:** Brighton 313 227-7067. Grand Rapids 616 363-9839. **MN:** 612 645-5816. **MS:** (AL) 205 883-8660. **MO:** 816 765-3337. **MT:** (CO) 303 355-2363. **NB:** (MO) 816 765-3337. **NH:** (MA) 617 729-5770. **NJ:** (No.) 201 224-6911. (So.) 215/542-9876. **NV:** (AZ) 602 994-5400. **NM:** 505 292-1212. **NY:** Metro LI(NJ) 201 224-6911. N Syracuse 315/699-2651. Fairport 716 223-4490. Utica 315 732-1801. **NC:** 919 683-1580. **ND:** (MN) 612 645-5816. **OH:** Cleveland 216 398-9200. Dayton 513 435-7684. **OK:** USDATA Assoc. 918 252-9646. **OR:** 503 644-5900. **PA:** (E) 215 542-9876. (W) 412 922-5110. **RI:** (MA) 617 729-5770. **SC:** 803/798-8070. **SD:** (MN) 612 645-5816. **TN:** 615 482-5761. **TX:** Austin 512 454-3579. Dallas 214 661-9633. El Paso Area (Las Cruces, NM) 505 524-9693. Houston Only 713 681-0200 **UT:** 801 292-8145. **VT:** (MA) 617 729-5770. **VA:** 703 569-1502. **WA:** 206 455-9180. **WV:** (PA) 412 922-5110. **WI:** (IL) 312 564-5440. **WY:** (CO) 303 355-2363.

**EUROPEAN EXPORT SALES: EUROPE:** (MA) 617 661-9424. **BELGIUM:** Noron S A., Brussels 02-24236-04. **DENMARK:** 02-913255. **FRANCE:** Rueil Malmaison 749-47-65. Paris 33-1-306-4606. **GREECE:** Athens 642-1368. **ITALY:** Milano 02600733. **THE NETHERLANDS:** Poeldijk 01749-47640. Amsterdam 020-360904. **SPAIN:** Mecorsa. Barcelona. TELEX 813-53908. **SWEDEN:** Teleinstruments AB, Vallingby. 08-380-370. **SWITZERLAND:** Mutschellen 057-546-55. **UNITED KINGDOM:** Bournemouth 0201671181. **ICELAND:** Benco. Ltd., Reykjavik. 091-21945. **WEST GERMANY:** Koblenz 01149-31025 6. **AUSTRALIA & NEW ZEALAND:** Auckland 876-570. Canberra 58-1811. Chermside 59-6436. Christchurch 796-210. Melbourne 03-543-2077. Sydney 02-808-1444. Wainuiomata 644-585 **CANADA:** Dorval 514 636-9774. Ottawa 613 224-1391. Toronto 416 787-1208. Vancouver 604 684-8625. **CENTRAL AND SOUTH AMERICA & CARIBBEAN:** (GA) 404 394-9603. **MEXICO:** Monterrey 564-876. **FAR EAST:** (CA) 213 382-1107. **HONG KONG:** Comptec. Hong Kong. 03-463-9921. **JAPAN:** (Tokyo) (03) 463-9921. **TAIWAN:** (Taipei) 02 7022156. **MIDDLE EAST:** (GA) 404 581-0243 **EGYPT:** 809933. **KUWAIT:** Kuwait 438-180 1 2. **LEBANON:** Beirut 221731 260110. **SAUDI ARABIA:** Jeddah 27790. Riyadh 25083-39732

For sales and service in other countries contact ISC headquarters in Norcross. GA U S A

**Intelligent Systems Corp.®** ✓76

Intecolor Drive ☐ 225 Technology Park/Atlanta ☐ Norcross, GA 30092 ☐ Telephone 404/449-5961 ☐ TWX 810-766-1581

# micro info

$ This symbol next to a title in the table of contents indicates that the article is a business-application article.

## Manuscripts

Contributions in the form of manuscripts with drawings and/or photographs are welcome and will be considered for possible publication. We can assume no responsibility for loss or damage to any material. Please enclose a self-addressed, stamped envelope with each submission. Payment for the use of any unsolicited material will be made upon acceptance. All contributions should be directed to the *Microcomputing* editorial offices. "How to Write for Microcomputing" guidelines are available upon request.


## Editorial Offices:

Pine Street
Peterborough NH 03458
Phone: 603-924-3873

## Advertising Offices:

Elm Street
Peterborough NH 03458
Phone: 603-924-7138

## Circulation Offices:

Elm Street
Peterborough NH 03458
Phone: 603-924-7296


## To subscribe, renew or change an address:

Write to *Microcomputing*, Subscription Department, PO Box 997, Farmingdale NY 11737. For renewals and changes of address, include the address label from your most recent issue of *Microcomputing*. For gift subscriptions, include your name and address as well as those of gift recipients. Postmaster: Send form #3579 to *Microcomputing*, Subscription Services, PO Box 997, Farmingdale NY 11737.

## Subscription problem or question:

Write to *Microcomputing*, Subscription Department, PO Box 997, Farmingdale NY 11737. Please include an address label.


Kilobaud *Microcomputing* (ISSN 0192-4575) is published monthly by Wayne Green, Inc., 80 Pine St., Peterborough NH 03458. Subscription rates in U.S. are $25 for one year and $53 for three years. In Canada: $27 for one year only, U.S. funds. Foreign subscriptions (surface mail)—$35 for one year only, U.S. funds. Foreign air mail subscriptions—$62 for one year only, U.S. funds. In Europe, contact: Monika Nedela, Markstr. 3, D-7778 Markdorf, W. Germany. South African Distributor: KB Microcomputing, PO Box 782815, Sandton, South Africa 2146. Australian Distributor: Electronic Concepts, Attention: Rudi Hoess, 55 Clarence Street, Sidney 2000, Australia. Second-class postage paid at Peterborough NH 03458 and at additional mailing offices. Phone: 603-924-3873.




kilobaud

# MICROCOMPUTING™


# contents: December '80

## ARTICLES



## DEPARTMENTS



This month's cover features the Apple Hill Chamber Players, a unique group of recording artists and concert performers who have toured the United States. Based in East Sullivan, N.H., the Players hold musical instruction sessions at the Apple Hill Center for Chamber Music. Members include (seated, left to right): Valeria Vilker, John Laughton, Betty Hauck and Beth Pearson; (standing, left to right) Anthony Princiotti, Robert Merfeld, Richard Hartshorne and Eric Stumacher. Joining the group at the synthesizer keyboard is Dennis Bathory Kitsz, who contributed three articles to this special music issue. Photos by Peter Acker.

*Wayne Green*

# PUBLISHER'S REMARKS

## Broker—The Name Should Be a Clue

With the word that Apple will be going public this fall, many people are calling their brokers to be put on the list to buy the stock. I haven't talked much with Apple, so I don't know what is really going on there. But on the surface it appears as if they have been growing faster than their cash resources, and thus need investors to help out.

Those in the firm with stock will make out well because going public sets a definite value on their stock. This usually makes instant millionaires out of the people in a firm who own large blocks of stock. It also helps out the people who provided venture capital along the way by giving them a substantial return on their investment.

Since Apple is growing rapidly, this looks like a good time for them to go public and take advantage of their place in the present market. But I see some heavy shadows ahead for Apple which might turn the investment sour in a year or so unless some changes are soon made in basic policy.

The problem for Apple is not Radio Shack or Commodore. The problem I see looming for Apple comes from the West—from Japan. Several of the large Japanese firms are coming to the U.S., and there has been a good deal of publicity in Japan about that country taking over one more high-technology industry—microcomputing. I think we can assume that the Japanese are serious about this. Taking a critical look at their previous attempts to take over high-technology industries, we see that they have a truly remarkable record of success.

So far we have seen shadows cast by Casio, Quasar, Panasonic, Hitachi, Toshiba, NEC and a few others. They seem to be definitely coming. I've talked with most of them and can assure you that not only are they coming to the U.S., but they also have definite plans for doing very well here. Casio, for instance, as I have mentioned before, has a goal of becoming the largest microcomputer firm within two years. If Casio comes into the United States with a library of a couple of hundred programs available from their dealers, they might be able to achieve their plans in one year instead of two.

Despite the lead Radio Shack has, I think Casio can do it, if they are smart. We've seen no indication of Casio not being smart. I wish I could say the same for some U.S. firms.

Every one of the American firms has a serious weakness, which, I think, is fatal. The weakness, of course, has to do with the fundamental hoax behind the selling of computers: the lack of significant applications software. I've talked with people in most of these firms and tried to reason with them, but there is an odd blindness that all of them share. The

**The problem I see looming for Apple comes from the West—from Japan.**

Japanese may take advantage of this and thus take over the market.

While I expect the Apple stock to go up very well for the immediate weeks after it is put on the market, unless there are some major changes in business philosophy at Apple, I would not want to hold onto the stock for long. I'd watch the Japanese inroads and marketing. Once they seem to be gaining hold, it might be time to look elsewhere for investments. I mentioned this concept to *Business Week* in an interview recently; we'll see what comes of that.

We've been watching the Tandy stock zooming upwards, pushed up by the success of the TRS-80. But what will happen to that stock if Casio, Quasar and others out-market Tandy? The Japanese are not novices at marketing, distribution, service, advertising or product design. Even if they don't discover the fundamental weakness of the American firms, they will be able to cause a lot of trouble. If they figure out the more basic answers, they can rout Radio Shack, Apple and the rest of them. What do *you* think that would do to Apple stock and Tandy stock?

## Software Shakeout

One after another more prominent software publishers have either bitten the dust, been bought out or received venture capital (passed the hat) in order to stay in business. It's a very rough world selling software.

For the most part, the problems have been self-generated. Even the largest firms, with a few exceptions, have put out so much third-rate software that dealers have become almost totally disillusioned. No dealer wants customers to come back into the store cursing him out for foisting off some dog of a program on them. After this happens often enough, the dealers become very cautious about stocking *any* software.

Small software firms have a serious problem too. Not only are dealers gun-shy about taking on software, but they also find it expensive to try and deal with a raft of small firms. There is just too much paperwork involved. So, with small firms too difficult to deal with and many of the larger firms putting out reams of crap, dealers are between a rock and a hard place.

You can add another problem to the list: tape-duplicating miseries. There is a profound ignorance in the field about tape formats and standards, and as a result, very few software firms have the expertise or the equipment to turn out cassettes that will load successfully. This has not stopped them from doing a half-assed job and sending out the result, which aggravates both customers and dealers. It took our engineers at Instant Software almost a year of hard work to develop a tape-duplicating system that works dependably. Some of the other firms that are also able to make good duplicates agree that it is not for the fainthearted. Even Radio Shack had one hell of a time with this. They had to spend a lot of money before they produced a dependable result.

Virtually nothing has been written about cassette tape-recording formats and systems. I'd like to see some articles on this arcane subject, and so would about 500 software firms. Most outfits have been going by the seat of the pants, empirically finding out what will or won't work, but not knowing why. We need information published.

In the meanwhile, we are seeing fewer of those beautiful full-color ads from software firms, who find they have overestimated the current market and fold up. Other than Instant Software, how many firms are selling over $1 million per year in software? Not many.

## Software Copyrights

As many people in the field predicted, the courts have overturned the decision on the JS&A case...insofar as the copyright matter was concerned. JS&A still came out free on the case, but this time because the appeals court felt that the owner of the ROM that was copied by JS&A had not adequately shown copyright ownership by stamping the ROM *with its logo.*

The business about the machine-readable code was thrown out, thank heavens. Now we have a situation where the courts are in step with the world again, and software is protected by copyright...as long as it is so marked, either on the ROM, the cassette or the disk.

It is difficult to reconcile the recent book by Joe Sugarman, the president of JS&A, which makes a big deal out of honesty, with the JS&A ripoff of the Data Cash chess ROM. Data Cash had a big investment in the program and thought they had the ROM protected, but through the usual legal mess, they were poorly advised and Sugarman got away with it. Joe may be legally clear on this, but it certainly appears that he is morally wrong and ill-equipped to be lecturing people about honesty.

# PET-POURRI

Robert W. Baker

## ROM Changes?

Some time back, a number of 16K and 32K PETs were shipped with five operating system ROMs instead of the usual four. It appears that Commodore ran out of 4K ROMs and installed two 2K 24-pin retrofit ROMs to replace the missing 4K ROM. To facilitate the fix, a jumper was installed and one connection was cut on the printed-circuit board. The ROMs at each end (UD9 on the left and UD3 on the right) are the 2K ROMs; the other three are 4K ROMs.

Now the plot thickens! You have a problem when you want to use any product that has a ROM that must plug into the rightmost socket (UD3), which would normally be empty. First, the socket is not empty. Second, the addressing for the socket has been changed. However, there are several ways to get around these problems:

1. You can upgrade to BASIC 4.0 (Disk BASIC). This simply involves removing the original five ROMs and installing the five new ROMs for BASIC 4.0. The new ROMs go into the left five sockets (UD6–UD9), leaving the two rightmost sockets free. This leaves space for a Word Pro ROM in UD4 and whatever you want in UD3.
2. Get the original 4K ROM for UD9 to replace the two 2K ROMs. This is Commodore part number 901465-03. Since I've had little luck locating one, I'm not sure of the current price or availability.
3. Connect both 2K ROMs to the UD9 socket. Since the address decoding is contained within the 2K ROM chips, you can simply connect them in parallel, and they'll appear to be a single 4K chip to the system.

One way to accomplish this is to piggyback the two 2K ROMs, solder the pins together and somehow insert the package into the UD9 socket. This has several disadvantages, however, since the chips can be damaged very easily if not handled properly. Also, the chips could easily overheat when they are mounted closely together and power is applied.

Another, much simpler, method of paralleling the chips is to use a modified Spacemaker board. Cut the connection from pin 8 of the 74LS08 chip and add a jumper wire between pin 21 of each ROM socket on the Spacemaker. This modification enables both ROMs on the board instead of selecting them one at a time. Then insert the two 2K ROMs in the Spacemaker sockets and insert the Spacemaker in the PET UD9 socket. To be safe, you might want to remove the ROM selector switch from the Spacemaker, since it is no longer used.

No matter which method you use to free the rightmost socket (UD3), you must restore the PET logic board to the original wiring of UD3. This requires removing the jumper on the back of the board just behind the UD3 socket. Also, repair the cut connection on top of the board to the right of UD3 near pin 4. Be careful when soldering the logic board, since there are MOS devices present. If you're unsure of the proper precautions, have a qualified person do the work.

## New Character Generator ROMs

West River Electronics, PO Box 605, Stony Brook, NY 11790, has a number of special character generator ROMs available for the PET. These ROMs provide special mathematical symbols or characters needed for various foreign languages.

The most popular ROM is the math character set ROM, which displays formulas and expressions in standard mathematical notation. Nothing is changed in the standard graphics font, but in the lowercase font (POKE 59468,14), the graphics characters have been redefined as mathematical symbols. The new characters include superscripted variables, numbers and operators (0–9, c, n, t, x, y, +, –, / and =). These can be used for both exponentiation and subscripting. There is also a two-part integral sign and a three-part radical sign that can expand to any needed size. Greek letters, along with an infinity sign, are useful for many applications. The forward arrow can be used for vector notation and limits. Additional operators, such as plus-and-minus, less-than-or-equal, greater-than-or-equal and not-equal, are also provided.

Remember that only the seldom used lowercase graphics characters have been changed, so almost all programs that worked with the original ROM should still work with the math character set ROM. This new ROM is currently only available for the new model PETs. An adaptor for old PETs and a software switch to allow you to switch between ROMs with a simple PEEK is under development. Additional foreign language ROMs are available for German, French, Spanish, Czech and Polish. Each ROM is $75, postpaid.

## Gridiron Scout

If you're a football enthusiast, then you might be interested in several programs offered by Ron Brinegar of Lyon TV, 19515 Village Drive, Sonora, CA 95370. Gridiron Scout evaluates football team tendencies to run certain plays in each down situation. The program requires a 32K PET; a printer is optional. It generates six types of reports based on the play

data entered:

- overall team offensive performance
- individual offensive performance
- play data review (with editing)
- kickoff review (with editing)
- analysis of down and formation tendencies for short, medium and long yardage
- summary of team tendencies defining where the defense is needed

The analysis report indicates how often the team runs or passes in each yardage situation, defining where the runner enters the line and the type of pass used. A final report gives an overall summary of the team's offensive tendencies, indicating how often the team runs or passes to each side. Similar statistics can also be obtained for kickoffs as well.

The program allows you to define the specific passing plays and offensive formations to be evaluated. The description of each is limited to 12 characters, but there is no specific limit on the number of entries to be coded. Play data is entered from the keyboard and can be saved to or restored from tape. Each entry is checked for validity whenever possible as it is entered. Once the play data has been entered, various statistics can then be obtained and analyzed as desired.

The available overall team statistics include:

- yards gained rushing
- total attempted passes
- total passes completed
- total incomplete passes
- average gain per pass
- total number of punts
- average yards per punt
- total number of kickoffs
- average kickoff return

Information on an individual player's offensive performance includes rushing, punting, passing and receiving.

The program lets you review and check the data entered, and even make changes if required. Overall, this is an interesting, well-written and possibly quite useful program for the PET. An NFL Prediction program is also available from the same author.

## Programming Hints

Most PET owners are usually aware of many ways of saving space within BASIC programs on the PET. Commodore even includes an appendix in their manuals to briefly mention several ways to save space and improve the efficiency of your programs. With most new 16 or 32K PET/CBM systems, saving space is not really as important as decreasing the program's running time. This is especially true when you have many reads and writes to the disk. A simple change to an input or output subroutine may make a drastic change in the time it takes to run the program or perform a special task within the program.

Usually, saving space within a BASIC program also decreases the program's running time. Let's first take a quick look at the various ways to save space, just in case there might be something you've overlooked:

1. Use multiple statements per line with a separating colon. There is a five-byte overhead associated with every BASIC line regardless of its length.

2. Use small line numbers. The line number of each line always takes two bytes regardless of the number of digits in the number. However, every line number used within a BASIC statement can waste space if larger line numbers are used. Each line number used in a statement takes one byte for every digit in the number. Correspondingly, use short variable names wherever possible.

3. Delete all unnecessary spaces and remarks.

4. A program need not end with an end statement. It can usually be deleted if the last line in a program is the last line to be executed.

5. Use a variable equated to the value of commonly used constant values. This especially applies to strings, since the string variable pointer will actually point to the text in the BASIC line where it is defined, instead of using the variable space at the top of memory.

6. Reuse variables wherever possible, rather than define additional variables.

7. Use the zero element of arrays and always declare an array's size. Avoid using arrays when simple variables will work just as well.

8. Watch the use of integer variables. Simple integer variables still take seven bytes per variable, but integer array elements save memory by using two bytes per array element. If you use simple integer variables such as I%, you'll actually waste space by using percent signs each time you reference the variable. However, if this forces using the INT function, you may be better off using the simple integer variables in certain instances.

9. Don't initialize variables to zero or strings to a null string. These are the default values set by BASIC when the variable is first encountered during execution.

10. Avoid using parentheses in expressions if not really needed for the proper interpretation of the statement.

11. Combine next statements if nested loops have a common exit. For example, 100 NEXT J,K,L.

12. Constant data used by a program can be read into an array from an external data file on tape or disk, rather than from data statements within the program. Alternately, the data can be used directly from the data statements without being placed into an array. By using the restore command, the data can be reused any number of times.

13. Use TAB and SPC functions to avoid using extra spaces within print statements.

14. Skip punctuation within multiple-item print statements whenever possible. The default is a semicolon spacing.

15. Omit closing quotation marks in any print statement not followed by other items to be printed in the same statement, or not followed by a colon and another BASIC statement.

16. Omit quotation marks around string element values in data statements. Quotes are only required if there are spaces or special characters (graphics, cursor control, commas, colons, etc.) in the data statement.

17. As usual, always use subroutines to perform common functions needed at various points in the program.

Generally, most of these space-saving techniques will also save time. There are, however, several additional techniques to save execution time that may not actually affect the size of a program. They may, in fact, even increase the size of a program in some instances.

1. Use variables instead of constants wherever possible. It takes more time to convert a constant to its floating-point representation than it does to fetch the value of a simple or array variable.

2. Order the definitions of variables carefully. Variables are defined in the variable table in the order they are encountered during execution. Whenever a variable is referenced by the program, BASIC must scan from the start of the variable table to find the desired value. Thus, those defined first can be located the quickest. Define most often used variables first. It may even be advantageous to define certain variables with dummy values at the start of the program just to get them into the variable table in a specific order.

3. Define simple variables before using a large array. Whenever a simple variable is defined, any arrays that exist must be moved in memory to provide space for the new simple variable entry. Also, all array pointers must be modified accordingly after the arrays are moved.

4. Keep heavily used subroutines near the start of the program. Most people are in the habit of placing subroutines near the end of their programs. However, every time the subroutine is called, BASIC must search from the start of the program to find the desired line. This could waste a great deal of time, especially if the subroutine is used for reading or writing data files.

5. Carefully examine the contents and structure of every for-next loop, which is possibly the most notorious time-waster if not handled properly. Make sure any statements that do not need to be repeated for each iteration of the loop are actually outside of the loop. If a value must be computed or a substring value used repeatedly within the loop, calculate the value once and define it as another variable that can be used as needed.

6. Use next statements without the index variable. NEXT is somewhat faster than NEXT X, because no check is made to see if the variable used is the same variable in the most recent for statement.

7. Combine operations whenever possible in the program flow. If your program is going to read data into an array and then sort it, place the entry in the correct array position and shift the remaining entries accordingly as each item is read. This is especially helpful when you manually enter the data from the keyboard. The program's user may not even notice a short delay between each entry, but a long delay later to sort an entire matrix may be rather annoying.

8. Since string garbage collection can waste a good deal of time, it may be best to force a garbage collection at specific times within the program. Simply execute F=FRE(0) statements whenever desired. You might consider doing this before waiting for a user response, since you don't really care about lost time at that point.

I hope this information will help you to write more efficient and therefore more useful programs.

Walter Koetke

# COMPUTER BLACKBOARD

## Selecting a Microcomputer

There remain few educators who are not well aware of the growing impact of microcomputers upon education. While many of the short-term and most of the long-term effects of this impact are unclear, one fact is very apparent: Educators and school districts are purchasing impressively large numbers of microcomputers.

Many of these purchases are very well intended, but incorrect. The first question asked by many educators and parents is, "Which computer shall I buy?" This is not an appropriate first question. The first question should be, "Why do I want a computer?" or "What do I want to do with a computer?" Only after you have adequately clarified your answers to the proper first question should you begin to address the task of actually selecting the microcomputer hardware. Hopefully this article will help you address both of these questions.

"Why do I need a microcomputer in my home?" is being asked with increased frequency. The answer is easy—you don't need one. There is very little chance that you really need a microcomputer in your home without being well aware of that need. On the other hand, "What might I do with a microcomputer in my home if I bought one tomorrow?" is a more valid question. In my opinion the answer is very straightforward.

Today, a microcomputer in your home can be used for recreation, education and personal business. As you scan the software advertisements, you'll see programs offered as home applications, such as a recipe record for the disorganized cook, a checkbook balancer for the exhausted breadwinner and a message center for the active family in which verbal communication has become difficult. If such software makes you skeptical, your first gold star has been earned. Let no one again consider you a computer illiterate.

Will the average household really use a computer to maintain a recipe file? I doubt it. We can overlook the fact that the kitchen's humid, relatively polluted air would not be healthy for most keyboards and look only to a couple of other already available tools. I suggest that an annotated cookbook and an index card file are both more effective tools than the computer for maintenance of recipes in the majority of homes. As for balancing your checkbook, I'm convinced that if you can afford to purchase a microcomputer, you are quite capable of quickly and accurately balancing your checkbook without computer support.

The current appropriateness of a family message center is a more interesting question, as improved communications will quite likely become one major consequence of the proliferation of microcomputers. However, once again I suggest the existence of other tools that can do the same job more effectively—pencil and paper.

**After you've clarified the particular applications in which you're interested... you're ready to address the question of which microcomputer should be purchased.**

I am a strong advocate of computer technology, and in many cases that technology should and will replace the paper and pencil. For example, the preparation of manuscripts without computer-based word processing support is no longer an effective use of time. But leaving messages for other family members is not a defendable application of today's microcomputer.

Now let's be more positive, for I do advocate the acquisition of microcomputers for the home whenever such acquisition is not a financial burden. What do the proposed applications of recreation, education and personal business suggest?

Recreation includes games, anything with little purpose other than fun, hobby applications and even learning to program if the learner is doing so for relaxation and enjoyment. If a computer in the home is defined for a microcomputer system that costs no more than $1200, then the majority of software for today's computers in the home falls into the recreational category.

Education includes drill and practice in a wide variety of areas including spelling, mathematics, historical facts, musical notes and even atomic structure. Education also includes such applications as simulations in several course areas, learning to program, problem solving, elementary word processing and computer literacy. I certainly believe that the availability of a computer in the home will positively affect the education of most children.

Personal business applications include those needs whose existence is all too familiar. If you're spending several hours each week tracking many stocks, maintaining tax records, editing and retyping manuscripts or typing address labels, then a computer in the home may be just what you need. However, if your stocks are simply scanned in the paper, your taxes consume only eight hours of your time each April, your writing efforts are usually limited to paying bills and your address lists pertain only to holidays and relatives, then personal business is not a valid justification for your microcomputer in the home.

What might you do with a computer in the school? The answer is everything discussed so far and a good deal more. I hope a partial answer is suggested by this column each month. Justification of the school computer is easier than justifying the computer in the home. In my opinion, reading, writing and computing really are the basic skills needed by today's children. Without even considering how to best teach reading or writing, there is little doubt that computers are an essential component when one teaches computing.

Although school budgets are very limited, schools are likely to purchase or otherwise acquire larger software libraries for their microcomputers than would the typical home user. This is reasonable not only due to cost, but also because many programs not appropriate for home use can be effective examples of a larger process in the school environment.

By using and then understanding the overall concepts and programming techniques of a well-written recipe maintenance program, students can better understand the techniques of searching and sorting over larger data bases. Although searching for recipes containing spinach and noodles because that's what's available in the kitchen is not practical, the same concepts apply to searching a computer file for all likely donors of a particular blood type or for the name of the owner of a car seen leaving an accident scene.

While the program to balance a checkbook was not a practical way to balance a checkbook, that program may be an effective instructional tool when teaching children how to balance a checkbook for the first time. While a family message center program had little value at home, the overall concept and programming techniques are very important ideas for today's students who must understand the fundamental ideas of computer-based communication networks that will gradually become so much a part of their daily lives.

After you've formulated a realistic answer to the question of why you would like a computer,

you must establish the position of the computer within your own priorities. If for your home, does computer acquisition come before or after additional attic insulation, a new microwave oven, an extra week of vacation or the security of additional savings? If for your school, does computer acquisition come before or after a new scoreboard, new history textbooks for three classes, a sofa for the faculty workroom or a part-time lunchroom employee? These are not always easy questions to answer.

The importance of realizing the necessity of placing the microcomputer within your overall priorities was dramatized at a recent statewide convention of school-board members. While enjoying the role of exhibitor, I had the opportunity to speak to a very elderly woman who was a school-board member in a relatively remote school district. She was very well informed regarding the possible uses of microcomputers in the classroom and examined the displayed courseware with enthusiasm.

She concluded her very friendly, supportive visit with the remark that microcomputers will never enter her school district. She quite simply explained that her fellow board members had, for the third consecutive year, refused to approve the purchase of colored paper for their kindergarten. She was adamant that students would have free access to colored paper before they had access to computers. Her priorities were very clear.

After you've clarified the particular applications in which you're interested, as well as established the relative priority of your computer purchase, you're ready to address the question of which microcomputer should be purchased. To do this properly, you must stick to the question of "What will this piece of hardware do for me?" rather than "Who manufactured this equipment?" The brand name is far less important than the hardware's function.

You may have heard of the Kurzweil machine, a computer-based device that will read aloud virtually any printed document. Originally developed for the blind, the machine has controls that allow the user to have sentences repeated or difficult words spelled. If you see the machine in action, you have to be impressed. Most of us can only imagine the degree of freedom and independence this device provides to a blind user.

Does it matter who made the computer housed within the Kurzweil machine? Not at all. The machine's function—the ability to read a printed page to the user—is the critical issue. Buyers of the Kurzweil machine are purchasing a function, not a particular brand of computer.

There are several appealing sales considerations that, in my opinion, are repeatedly overemphasized. Foremost of these is the idea that the microcomputer you purchase must provide for considerable expansion in the future. This concept was likely derived from experience with minicomputers and larger mainframes. When acquiring these larger systems, consideration of expansion was important, but with today's microcomputers such considerations are of far less importance. My suggested de-emphasis is based primarily on the rapid increase in the amount of computer technology available for each dollar spent.

Suppose you're well prepared with your list of all likely applications of your microcomputer for the first 18 months and that you have realistic expectations regarding software availability and price. Your local hardware vendor shows you two microcomputers: brand A which costs \$X, and brand B, which costs \$3X —either of which will meet all of your functional requirements. However, brand B has two or three really nice features missing on A, to say nothing of the ability to add additional disks or memory in the future. Hopefully you won't be tempted. Brand B may be everything it's supposed to be, but you certainly shouldn't pay an additional \$2X for extra features that aren't necessary for the functions you desire.

But what about the future? Won't you satisfy your planned needs for 18 months and then wish you could expand? Quite likely you will. However, I suggest that in 18 months you'll be able to purchase all of the capabilities you then need at a cost that is less than that of adding options to your already outdated machine. Remember that if general consumers can purchase computer technology, that technology is probably already outdated.

How do you know that the computer you select today will continue to make you happy in the future? You can't be positive, but if your list of applications is valid, your computer is not likely to become totally obsolete. While teaching yourself BASIC may be fully accomplished, applications such as providing a computer literacy experience or a problem-solving resource for students will be even more necessary in the future than they are today.

If the hardware you select fully satisfies your well-planned applications today, that hardware will continue to complete all appropriate applications in the future. That newer, flashier hardware will be available is a certainty, but that fact does not diminish your needs for particular applications nor a somewhat older piece of hardware's ability to satisfy those needs. If your original reasons for selecting a piece of hardware today are valid, they will continue to be valid in the future.

The selection of computer hardware should not be a one-time effort. If your school already has several of brand A or brand C, that fact should be of minor importance as you select additional hardware. Your applications must be uppermost in your mind. Purchasing additional hardware just because it matches that which you or a neighbor already owns is a consideration, but definitely not an overwhelming one.

For example, the most appropriate microcomputer for teaching programming is definitely not the same piece of hardware that is most appropriate for running small-computer-managed instructional systems. Dealing with two or more different pieces of hardware may appear excessively difficult, but only to the novice. Don't allow a salesman to capitalize on your initial naivete and sell you hardware just because someone you know has the same thing.

I hope you didn't expect this article to end with a specific recommendation of a particular piece of hardware. Such a recommendation really isn't defendable without first considering your planned applications. With objectives in hand, you should visit computer dealers, visit computer shows and read ads and reviews in current magazines. If possible, talk to owners of different types of hardware. After other resources are exhausted, you're welcome to one additional personal opinion. If you send me a list of your computer-related objectives, your address and your telephone number, I'll be happy to make some specific recommendations.

*Correspondence concerning this column should be addressed to Walter Koetke, Putnam/Northern Westchester BOCES, Yorktown Heights, NY 10598.*

# BOOK REVIEWS

### Etudes for Programmers

Charles Wetherell
Prentice-Hall, Englewood Cliffs, NJ
Softcover, 196 pp., \$12.95

My first course in programming used the etude method. Once we had learned enough BASIC for looping, I/O and other essentials, the instructor announced that our grade would depend on a programming project of our choice. The only restriction was that our projects should be challenging enough to keep us busy for the rest of the quarter.

My choice—a Kalah program with recursive subroutines—taught me more about program structure and programming than any collection of finger-exercises in coding BASIC could have.

If this book had been available back then, my education in programming would have been much faster, and more fun too.

Believing that programming is a skill, and is thus learned through practice, Wetherell seeks to create a set of real problems for apprentice programmers to practice on. He has succeeded admirably.

The problems are challenging, and Wetherell includes complete background material, superb bibliographies and "playing time" estimates. The last four projects are the toughest and most

intriguing; together they form the core of a course in compiler writing.

The other topics range from game programs (Life, Kalah, Mastermind and mazes) to number crunching and text handling (a symbolic algebra package, high-precision arithmetic and automatic text formatting). Two program solutions are given in the back of the book as illustrations of what to work for and what to avoid.

Each etude is introduced with background information that explains the real-world situation surrounding the problem. While not exhaustive, these remarks usually form the bulk of the chapter, and they are often entertaining and informative.

Once you've gotten your bearings, a short section details the program to be written. Following that is a discussion of potential problems (and hints for their solution), along with notes on language choice. Almost every etude has an annotated bibliography that can save you a lot of frustration and wasted time.

The drawback to this book is that it was written mainly for college students with access to a computer center. If you're running Tiny BASIC with 2K of workspace, all of the references to APL, LISP and Pascal might be intimidating.

The recent growth of Tiny C and Pascal is helpful here, and (as the author points out several times) solutions to the problems could be implemented in a variety of languages, including BASIC and assembly language. Some solution programs, in fact, have already appeared in this magazine.

This book makes a good companion volume to Kernighan and Plauger's *Software Tools,* and it is a must reference the next time you strike out on your own. Be the first in your neighborhood to add heuristics to Nuke the Wumpus!

**R. Tyler Sperry**
**Cardiff, CA**

## Software Engineering for Micros

T.G. Lewis
Hayden Book Company, Inc.
Rochelle Park, NJ, 1979
Softbound, 156 pp., $6.95

The microprocessor revolution initiated the precipitous decline in the cost of computer hardware, and thus ensured the rapid proliferation of microcomputers in virtually every facet of modern life. But while the hardware has become less expensive, the price of software has increased. Since the software for a system might cost several thousand times more than the hardware, there must be some orderly method of software development that will produce reliable, understandable and easy to upgrade programs in a minimum amount of time.

*Software Engineering for Micros* shows how to give discipline to the writing and design of software to achieve these goals.

The book begins by illustrating why order should be introduced into the design of software and why software should not be generated without some overall structure or organizational plan in mind. Lewis does this by introducing the concept of speedcode, a shorthand method of program writing. The speedcode method helps to define the structure of the program by describing the sequence of program operations in English statements. After the overall structure of the program has been finalized, it can be refined into pseudocode.

Pseudocode is also a series of English-like statements that describe program sequences, but unlike speedcode it goes into far more detail. The pseudocode can be further refined into kludgecode, which is the assembly language for the particular microprocessor. This insistence that the programmer design his program through successive levels of refinement gives the software a strong overall structure. The speedcode and pseudocode steps are independent of the microprocessor type; only the kludgecode, the final step, must be altered when the microprocessor type changes. Thus, the program can be rapidly adapted for another microprocessor.

The book discusses program decomposition, which is a method of writing a large program by breaking it into a number of smaller segments that are easily solvable, and includes a number of easy-to-follow examples.

What I like most about this book is that it is easy to understand. It includes plenty of examples that aid in understanding the general concepts of software engineering. The book was written as an instructional text for students of computer science, but since it is so well-organized and full of step-by-step examples, it is informative reading for the serious hobbyist or hobbyist about to turn professional.

For the serious student of microcomputers, the development of quality software will be a major concern for the next decade and beyond. This book is an excellent way to begin to develop proper software development habits to ensure that the systems you design are reliable.

**George D. Dooley**
**State College, PA**

## Basic Computer Programs in Science and Engineering

Jules H. Gilder
Hayden Book Company, Inc.
Rochelle Park, NJ
Softcover, 247 pp., $8.95

Most microcomputer software is written for business or entertainment purposes. Little good software is available for engineering or scientific applications—software that offers solutions to problems that occur in the real world.

I bought this book to see if it filled a software gap and lived up to my expectations. Surprisingly, it did.

The book consists of 114 programs, mostly related to engineering mathematics, data manipulation and electronic engineering. All of the programs deal with electronic engineering, which is lousy if you're not an electrical engineer but great if you are.

Whenever I buy a book of programs, half of them are usually repeats of common problems or are useless. This is not the case with Gilder's book. None of these programs could be classified as trivial—they are useful, well thought out time-savers. If I had to write all this software, the time consumed would be considerable.

The types of programs include solutions for simultaneous equations, Simpson's integration, matrix manipulation, linear regression, computer-aided circuit design, active filter design, communications and passive filters.

Each program includes a short discussion of the problem theory and any relevant equations, followed by the program listing and the output. The programs are written in Applesoft II BASIC, and with only minor modification can run on other microcomputers. I got some of the programs to run on my TRS-80 with little trouble.

My only complaints with the book are related to program style. The author gives little or no thought to structuring the programs, and does not list any program variables. Nor does he bother to divulge any algorithms or anything related to program logic. This might not be important if you are only interested in copying the program, but is if you are trying to understand or change it.

My other complaint concerns line numbering in the listings. The author skips around in numbering the program lines, and this makes it difficult if you are using a computer that has the AUTO line-numbering provision.

Overall, I would rate the quality of the programs as very high. The price is also reasonable. $8.95 works out to about 8 cents per program, which is quite a bargain.

**George D. Dooley**
**State College, PA**

# MICRO QUIZ

**Analysis of Algorithms**

How many times will statement 30 be executed during each execution of the following program?

```
10 READ A, B, C
20 L=A
30 IF INT(L/A)=L/A THEN GOTO 40
35 L=L+1; GOTO 30
40 IF INT(L/B)=L/B THEN GOTO 50
45 L=L+1; GOTO 30
50 IF INT(L/C)=L/C THEN GOTO 60
55 L=L+1; GOTO 30
60 DATA 12, 18, 24
```

*(answer on page 225)*

## "Lucky Visitor" Winner

Congratulations to James Ellenburg of Washington, D.C., who is the most recent winner of $100 worth of software from Instant Software. He was selected from those who attended the Washington, D.C. show. If you would like to be eligible to win a Level II TRS-80, then sign up for the free drawing at the *Kilobaud Microcomputing* booth the next time you attend a major microcomputing show.

# MICRO-SCOPE

## Reader's Digest Buys The Source

Since the early 60s, large corporations have been snatching up companies in the media and communications fields like steaks at a Supermarket Sweeps. In the book-publishing industry, many prominent houses are being absorbed by such megalith monsters as IT&T (Howard W. Sams, Bobbs-Merrill), CBS (Holt, Rinehart and Winston, W. B. Saunders, Fawcett Publications, Popular Library) and Xerox (Ginn & Company, R. R. Bowker Company). Others are grabbing major Hollywood film studios (Paramount Pictures by Gulf & Western, which also, incidentally, owns Simon & Schuster; Universal Pictures by MCA). Large newspaper chains reminiscent of the Blob are rolling across the land sweeping up juicy little franchises faster than media watchers can keep track (Gannett's holdings, for example, have increased in number from about 50 in 1975 to 82 by mid-1980).

Videotext services are no exception. The list of giants jumping into the pool is awesome. H&R Block, the tax people, have bought CompuServe; AT&T and the Knight-Ridder newspaper chain have an electronic news experiment going in Florida; Dow Jones is field-testing in Texas; Warner Cable has its QUBE system in Columbus, OH, and recently launched a similar project in Massachusetts; and CBS has a cable experiment going in St. Louis, and has filed a petition with the Federal Communications Commission asking that television broadcast licensees be permitted to transmit teletext.

Thus, it came as no surprise that the Source Telecomputing Corporation, this country's largest interactive computer information service, recently gave up its independence in favor of the security a larger, more financially stable organization offers. The surprise was who made the purchase: Reader's Digest Association, Inc.

Why did Reader's Digest, that paragon of conservative values ensconced in virtually every middle-American bathroom, make what Source Chairman Jack Taub called "the boldest step into the field by a publisher"?

If one is to believe Taub, as quoted in the Washington *Post*, the reasons behind *RD*'s acquisition are as homey as the magazine. Several RD people, he says, were subscribers to The Source; they liked what they saw, and they convinced their buddies at the office that The Source would be a fun and profitable commodity to own.

This is a curious modus operendi for a modern company of RD's size. But assuming that the story is more truth than folklore, the question still remains: what did these enterprising and insightful RD people *see* in The Source?

If Reader's Digest has any far-reaching—or short-reaching, for that matter—plans, spokesman Charles Pintchman is keeping them under wraps.

"We entered the market because it is compatible with what we do," says Pintchman. "Electronic information is the future, it is going to be here, it *is* here, and we're a forward-looking company."

Translated, this means simply that progress is technology and technology is progress, which is more a philosophy than a reason.

In business, pragmatism must be translatable into dollars. Reader's Digest unquestionably sees profit potential in The Source. But beyond this, perhaps they are simply hedging their bets against the day when videotext systems might duplicate the kinds of services *Reader's Digest* magazine and Reader's Digest Condensed Novels now offer.

If Reader's Digest's motives are slightly unclear, The Source's are not. Despite Taub's chirpy assertion in an interview published in *Microcomputing* last month (but conducted before the sale) that "we are well-backed and the future is bright," rumors of The Source's financial woes have been circulating for some time.

"That was a rough period, as you probably know from the grapevine," confirms Source spokesman Eric Gagnon. "But we're now ready to start running a business instead of an experiment."

The Source undoubtedly will draw upon both the parent company's business acumen and financial resources. Several Reader's Digest people will sit on The Source's board of directors to proffer advice and make sure the traffic flows properly.

Just as importantly, Reader's Digest will lend The Source its prestige and influence.

"Reader's Digest will get our foot into the doors of databases that would be inaccessible otherwise," Gagnon says. While he won't mention any databases being lined up for the future, he says that Reader's Digest's purchase will speed up the acquisition of those already in the works, such as an encyclopedia and the *World Almanac and Book of Facts*.

Finally, the question everyone has been waiting for: Will Source subscribers now be able to read "Life in These United States" and "It Pays to Enrich Your Word Power" on their terminals? Not likely, says Gagnon.

"A lot of people have asked whether this means Reader's Digest will be on The Source,"

*The National Boy Scouts of America uses Texas Instruments Silent 700 Model 765 portable bubble memory data terminals to transmit accounting information from the national headquarters to 35 councils across the nation. Also, Explorers in the Irving, TX, area have formed a data-processing explorer post.*

he says. "But we'll continue to do our own thing, continue to provide the services we've been providing."

—E. M.

## RIP CRT Manufacturers

Some 85 percent of today's cathode-ray tube (CRT) manufacturers won't survive the 80s, says a report in the *Monosson View*.

The market will be dominated by a small number of large companies who will mass-produce low-end displays, the report continues.

"We are witnessing a market that is reaching a critical size that makes it attractive to large companies with mass production and large-scale distribution capabilities," says Adolf F. Monosson, chairman of American Computer Group, Inc., in Boston, MA.

The report says a shakeout will occur similar to ones in the automobile, television and calculator industries. When the dust clears, the *Monosson View* says, only 20 of 150 companies will still be in the CRT business.

The report is available from American Computer Group, Inc., PO Box 68, Kenmore Station, Boston, MA 02215 (617-261-1100) for $65.

## A Typewriter That Listens

A scene in the Peter Sellers movie *Being There* shows an old man lying in bed dictating into a microphone. As he speaks, each word appears on a video screen across the room.

Such technology is not as futuristic as it might have seemed to some viewers. An International Resource Development study says that voice-activated typewriters will be commercially available by 1983, and will be in widespread use by the end of the decade.

The study says that the first commercial versions will recognize about 95 percent of "typical" business English. Someone then types in words the machine failed to understand.

The IBM Displaywriter includes a 50,000 word vocabulary. While homonyms and other quirks of the English language make 100 percent accuracy impossible, the Displaywriter can recognize possible homonyms and highlight them for possible correction.

Other early developers of the VAT are Xerox, Matsushita and Exxon.

What impact will these machines have on the office environment? IRD predicts that more than one million typists and secretaries "will be redeployed—or unemployed." Also, says Celeste Hynes of the IRD research staff, secretaries "will find their jobs enriched and expanded as a result of the new technology."

On the home front, says IRD, speech recognition and voice synthesis will soon be used in home appliances and consumer products, including TV channel tuners and automobile ignition locks.

For further details on the report, entitled "Speech Recognition and Computer Voice Synthesis," contact IRD at 30 High St., Norwalk, CT 06851 (Phone 203-866-6914, Telex 64 3452).

**1980**

Rapid advances in speech recognition by Threshold Technology, IBM, Xerox/Kurzweil, Matsushita, Perception Technology and others. First announcement of commercial voice-activated typewriter, by Matsushita (for 1983 delivery).

**1983**

IBM starts delivering voice-activated version of Displaywriter product. Xerox announces high-end VAT. Matsushita delivering Japanese VATs.

**1985**

Worldwide VAT shipments reach 25,000. Other U.S. companies, probably including Exxon, active in VAT market.

**1986**

Some Luddite labor problems encountered in European market; probably few problems in U.S. Japanese VAT market grows rapidly.

**1987**

VAT shipments exceed 100,000. Larger volumes lead to significant price drops.

**1990**

Cumulative VAT shipments approach one million. Noticeable impact of VATs in routine of many offices. Value of VAT shipments exceeds value of regular typewriter shipments.

*Voice-activated typewriters will be on the market by 1983.*

Source: International Resource Development Corp.

## More from CompuServe

Commodity market information and continually updated stock prices from major exchanges are now being offered by CompuServe.

The commodity market information, from Commodity News Services, Inc., of Kansas City, will include pricing, news and commentary on energy, metals and agricultural commodities.

CNS provides commentary and statistics on futures trading from the exchange floor with updates at ten-minute intervals during the trading day. CNS also offers weather stories, agricultural and economic news of interest to farmers, businessmen and the investing public.

Also to become a daytime offering will be tabulation of each day's trading on the New York and American stock exchanges. Information will be continually updated throughout the trading day and will include weekly lists. Stocks, bonds and options; U.S. Treasury bills, bonds and notes; mutual funds and NASDAQ information could be included. This service is scheduled to start in early 1981.

Both features are part of CompuServe's new daytime access feature. A limited number of daytime subscribers will be able to hook up for $22.50 an hour. More subscriptions will become available as CompuServe expands.

Its other financial services include Standard and Poor's CompuStat database; Value, a security database; the QUBIT financial database; Acquimerge, a product of Alcar Associates, for merger and acquisition analysis; and the Value Line data base.

## News from Nexis

A new interactive news retrieval system for businesses is being offered by Mead Data Central, a Mead Corp. subsidiary.

Nexis makes available the full texts of a number of newspapers and magazines, in addition to several wire services. They include the Washington *Post*, *Newsweek*, *U.S. News and World Report*, UPI, AP and Reuters.

The service is used primarily for research. Subscribers can search the computers for information on the basis of a word or combination of words, and the computer will provide a list of stories in which those words appear.

The fee for the service is $50 a month, plus an hourly charge of from $1 to $1.50. Nexis has its own network of leased telephone lines, and also rents terminals.

MDC also provides a legal research service called Lexis.

## Antiques, Anyone?

A computer-based publication service has played a major role in compiling the *Official Sotheby Parke Bernet Price Guide to Antiques and Decorative Arts*.

InfoConversion, a division of Grumman Data Systems Corp. in Woodbury, NY, circumvented conventional editing and book-production methods by compiling the data on magnetic tape and feeding it directly through a typesetter to produce camera-ready copy. The company estimates that the process would have taken eight to ten times longer and cost at least four times as much if done without the computer.

"Up until now it was neither feasible nor economical to produce a popular-priced refer-

ence work of this magnitude," says the book's editor, Charles C. Colt, Jr. "Conventional editing and book-production methods were just too costly and time-consuming."

Colt says it is the first price-reference book of its kind. The book includes prices for over 32,000 fine art pieces and antiques and original decorative objects. Sotheby Parke Bernet is one of the world's leading auctioneers.

InfoConversion has used its service in the past to produce directories, technical and parts manuals, engineering proposals and other publications that require regular updating and republication. This is the first time they have worked on a project of such broad general interest.

## Tenpin Tabulations

AMF, bowling's leading equipment supplier, has developed a scoring and information program called DataMagic. Texas Instruments, whose Omni 800 model 820 keyboard send-receive data terminal provides the hardware, calls it "bowling's most advanced computerized scoring and information system."

"From a bowler's viewpoint, DataMagic saves time and trouble," says Bill Bogard, AMF director of product engineering. "League players used to wait a week for printouts, which are used to keep track of bowling averages, high and low games, team standings, handicaps and scratch averages. With DataMagic and the 820 KSR, bowlers can have scoring printouts within minutes."

When a bowler completes a game, the MagicScore unit transmits the information from the bowling lane to the DataMagic data base in the manager's office. The scoring data is then easily retrievable by keying in a request on the 820 KSR, and the bowling center owner or a league secretary can receive a scoring printout. The 820 KSR Data Terminal can provide up to five legible copies simultaneously at 150 characters-per-second (cps) printing speed.

But DataMagic wouldn't exist if it were concerned only with the happiness and comfort of the bowlers. Extra dollars await the entrepreneurial bowling alley manager.

"Most significantly, DataMagic can be used as a marketing tool to increase business," Bogard says. "One important marketing function DataMagic performs with the assistance of the 820 KSR is recording demographic information about bowlers."

The manager can use the information to compile special mass mailing lists.

"The DataMagic system helps bowling center owners boost profits," Bogard says. "The automatic scoring system brings in more open or nonleague players. And, of course, each new bowler attracted to the center for open play means a potential league bowler."

## Computer Likes Miss Kansas, But Judges Go Okie

Beauty and the computer?

George Miller, a professor at Northern Illinois University, used his computer last year to create a model of the quintessential Miss America pageant winner, matched the model with all of 1979's contestants, and made a prediction—Miss Mississippi. Much to everyone's surprise, Miller was right.

The 1980 pageant found Miller going for two in a row. But alas, while he predicted that Miss Kansas would win, the crown and scepter were passed on to Miss Oklahoma. Miss Kansas didn't even finish in the top ten.

## Familiar Tunes

Can consumers adjust to using their televisions for new purposes?

A recent report on video disks indicates that people like the familiar—nonparticipatory entertainment programs. Interactive programs rate a poor second.

The study, conducted by Venture Development Corp. in Wellesley, MA, shows that while almost two-thirds of those surveyed expressed a strong interest in recent movies and over half in movie classics, do-it-yourself programs received only 15.9 percent and sports lessons 8.3 percent.

Significantly, people showed a strong preference for programs that are familiar TV fare.

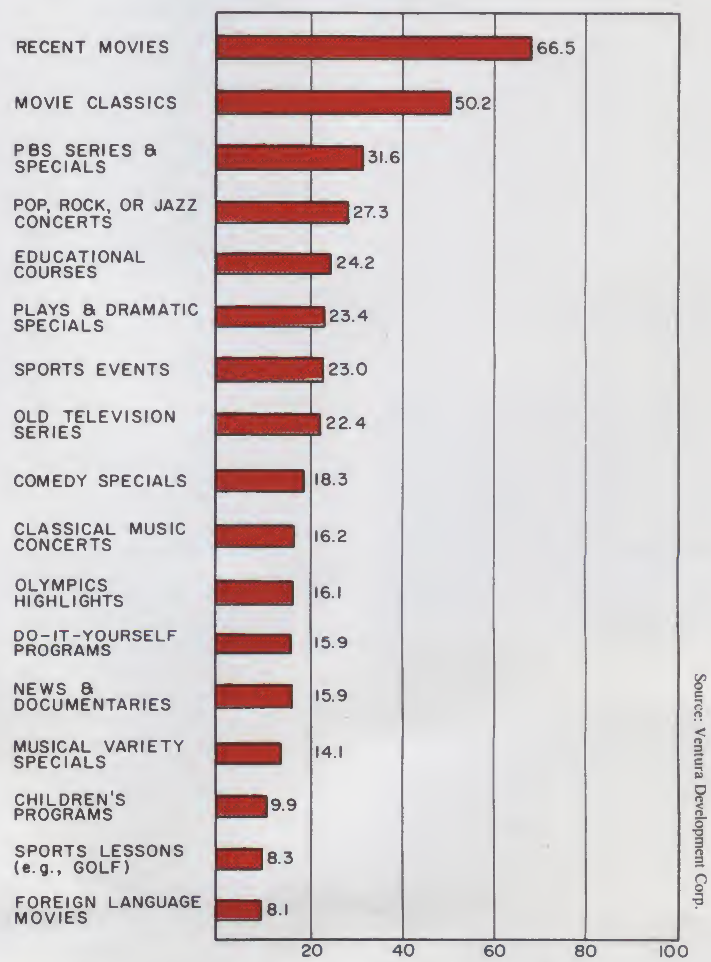
How does this apply to computers? Simply that it will be a while before consumers begin to explore nontraditional uses for their televisions, including videotext services. TV has provided passive entertainment for so long that people will have to "see" TV in a different light before they're comfortable interacting with it.

For more information on the Venture report, contact Raymond L. Boggs, consultant, One Washington St., Wellesley, MA 02181 (617-237-5080).

## Quote of the Month

"I feel quite simply that technology is a tool, and is as good as people make it. Artists have always taken advantage of technology. Bronze-casting, for example, or the invention of oil paint in the Renaissance were technological advances that opened up incredible vistas for artists. Not in and of themselves, just as computer graphics work is not in and of itself a real artistic use of the computer. I'm interested in transcending graphics, using the computer as a tool to find ideas, not just depict them."

**—Sculptor Jesse Kalfel of Belmont, MA, quoted in the Boston *Globe***




*Video disk users prefer familiar programs, a recent study says.*

Edited by Dennis Brisson

# NEW PRODUCTS

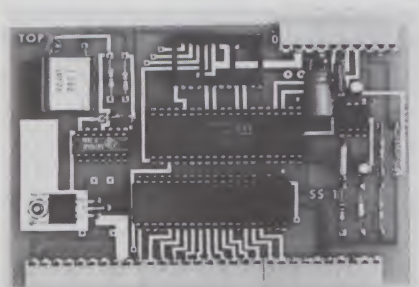
## 6800/6809 Sound Synthesizer Board

The SS-1 is a programmable sound synthesizer board for the SWTP S50 bus 6800 and 6809 computers. It consists of an assembled and tested S30 slot printed-circuit board and driving software, which enables the 16 internal registers of the sound synthesizer chip (the AY-3-8910) to be programmed from either the driving assembly language or BASIC language program.

You can produce a variety of sound effects and music from a combination of three independent sound channels, which can produce a tone and white noise. The amplitude of these three channels may be controlled independently, and an envelope shaper may be used to add attack and decay to the output waveform. Two bidirectional eight-bit ports are also provided onboard to connect keyboards or game paddles to the host computer. The board may be connected to an external power amplifier, or the onboard amplifier may be used by simply connecting an external loudspeaker.

Software is provided to generate sound effects and enables registers of the sound chip to be read or written to. An interface program to enable sound effects to be generated from BASIC is also provided, together with some sample BASIC language programs. Price is about $120.

Sirius Cybernetics, 7 Euston Place, Leamington Spa, Warwickshire, England CV32 4LN. Reader Service number 482.



*Sirius Cybernetics' SS-1 sound synthesizer board for the 6800/6809.*

## Microprocessor-Controlled Synthesizer

The Aries synthesizer system features microprocessor-controlled programmability and is designed to be configured in a variety of ways to match the capabilities of other popular programmable synthesizers. It features unique signal routing and gain control.

*Aries synthesizer from Rivera Music Services.*

This modular synthesizer is completely controlled by internal firmware and requires no additional software programming to operate. However, the systems data memory is accessible as a peripheral via any of the standard computer buses. This allows you to externally display and process the signals controlling the synthesizer.

Rivera Music Services, 48 Brighton Ave., Allston, MA 02134. Reader Service number 499.

## Apple Nine-Voice Music Synthesizer

The AM-II consists of software and a printed-circuit board that plugs into an Apple II and turns it into a simple-to-use nine-voice music synthesizer. The AM-II allows users to compose music with two game paddles (instead of keyboard commands), along with a graphic display of notes and the music staff. Users can select notes on the staff (from a six octave range) and duration and many other characteristics from a menu at the bottom of the screen. During playback of the music, the music is shown on an animated, 16-color display. It allows the nine voices in stereo. Software is available in cassette or disk versions. Price is $198.

Peripherals Plus, 119 Maple Ave., Morristown, NJ 07960. Reader Service number 486.

## ASCII-Encoded Keyboard Kit

The JE610 ASCII-encoded keyboard kit, which can be interfaced into almost any computer system, comes complete with a 62-key keyboard switch assembly, integrated circuits, sockets, connector, electronic components and a double-sided printed-circuit board. Easy-to-follow wiring instructions and circuit diagrams are also included. The keyboard switches are SPST mechanical action, and 60 keys generate the full 128 characters, upper and lowercase, of the ASCII set. Two user-defined keys are provided for custom applications. This unit is fully buffered, and there is a caps lock for uppercase alpha characters.

The heart of the system is a 40-pin ROM (AY5-2376) with outputs directly compatible with TTL/DTL or MOS logic arrays. The keyboard assembly requires +5 V dc at 150 mA and −12 V dc at 10 mA for operation. Interfacing is accomplished by a 16-pin DIP or an 18-pin edge card connector. Price is $79.95 (kit); the enclosure is available separately for $49.95.

Jameco Electronics, 1355 Shoreway Rd., Belmont, CA 94002. Reader Service number 483.

*Jameco's ASCII keyboard.*

## 6800 Single-Board Computer System

The Model SBC-02 computer is a minimal four-chip system on a 6 × 6 inch printed-circuit board, which features a 6802 processor with 128 bytes of RAM, 2K of EPROM and parallel or serial I/O. A wire-wrap area is provided for custom interfacing or other expansion. Applications for the SBC-02 include system development, limited-run production and school or company training programs. Prices are $25 for a bare board with instructions, $75 for a parallel I/O kit and $150 when wired and tested. Optionally, a machine-level monitor called HUMBUG can be installed to provide program entry and control, single-stepping, breakpoints and other front-panel functions from a serial terminal. HUMBUG runs on the four-chip system and is supplied separately in 2716 EPROM for $40 (included at no charge in the kit and wired versions). Additional support includes tutorial literature, 4K floating-point BASIC in ROM, a

# META TECHNOLOGIES
## FOR YOUR DISK SYSTEM

# FILE BOX
**DISKETTE STORAGE SYSTEM**

**$24.95 for 5¼" disks**
**for 8" disks . . . $29.95**

MTC brings you the ULTIMATE diskette storage system, at an affordable price. Storing 50 to 60 diskettes, this durable, smoke-colored acrylic unit provides easy access through the use of index dividers and adjustable tabs. Unique lid design provides dust-free protection and doubles as a carrying handle.

### PLASTIC LIBRARY CASES
(not shown)

An economical form of storage for 10 to 15 diskettes, and is suitable for your bookshelf! Case opens into a vertical holder for easy access.

5¼-inch diskette case . . . . . . . . . . . $3.25
8-inch diskette case . . . . . . . . . . . . . $3.50

Single Sided, Single Density, Soft-Sectored 5¼-inch, (for TRS-80™) Mini-floppy

# DISKETTES
**$19.80 ★ box of 10**

Meta Technologies strikes again . . . at the competition! These are factory fresh, absolutely first quality (no seconds!) mini-floppies. They are complete with envelopes, labels and write-protect tabs in a shrink-wrapped box.

INTRODUCING
## PLAIN JANE™
**DISKETTES**
**The Beautiful Floppy with the Magnetic Personality™**

In 1980 alone, MTC has sold nearly a third of a million dollars worth of brand-name diskettes. If anyone knows quality, we do. And these are quality diskettes. The catch? They are in a plain white box. You're not paying for fancy printing, fancy labels or fancy names on the packaging. We don't even put our own label on the package (labels cost money). At this introductory price (our regular price will be $21.95 per box of 10) we cannot offer quantity or dealer discounts.

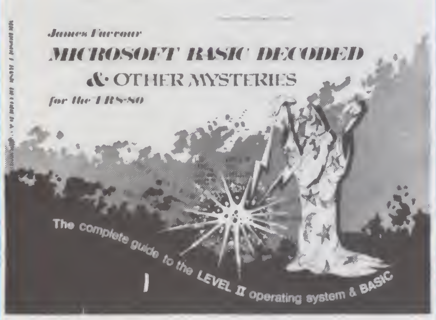
PLAIN JANE™ Diskettes . . . . . . $19.80★

VERBATIM brand Diskettes (box of 10)

5¼-inch (for TRS-80™)
MD525-01 . . . . . . . . . . . . . . . . . $23.95
10 boxes of 10 . . . (each box) . . . $22.95

8-inch FLOPPIES
Single-Density, FD34-1000 . . . $29.95
Double-Density, FD34-8000 . . $39.95

## TRS-80™ PRODUCTS




NEWDOS/80 by Apparat . . . . . . . . . . . $149.95
NEWDOS+ with ALL UTILITIES
35-track . . . . . . . . . . . . . . . . . . . . . . . $69.95
40-track . . . . . . . . . . . . . . . . . . . . . . . $79.95
TRS-80™ DISK AND OTHER MYSTERIES . . . $19.95
MICROSOFT™ BASIC DECODED & OTHER MYSTERIES for the TRS-80™ . . . . . . $29.95

### META TECHNOLOGIES REDEFINES "Customer Satisfaction" IN 1981

**met-a-mor-pho-sis** (met'ə môr' fə sis), *n., pl.* -ses (-sēz'). **1.** a transformation. **2.** a change or successive changes in character or appearance. **3. MTC's transition in 1981 to a bigger and better way of doing business, featuring new and improved products and services.**

CALL FOR INFORMATION ON OTHER TRS-80™ PRODUCTS

All products guaranteed for replacement only. Prices, Specifications & Offerings subject to change without notice.

MOST ORDERS SHIPPED WITHIN ONE BUSINESS DAY

★PRICE GOOD THRU DECEMBER 31, 1980. Sorry, no dealer or quantity discounts. Allow for possible shipping delays.

WE ACCEPT
- VISA
- MASTER CHARGE
- CHECKS
- MONEY ORDERS
- C.O.D.

- Add $2.50 for standard UPS shipping & handling
- $2.00 EXTRA for C.O.D.
- Ohio residents add 5½% sales tax.

TO PLACE ORDER 1-800-321-3552 | CALL TOLL FREE | FOR PRODUCT INFO 1-800-321-3640

IN OHIO (216)289-7500 (COLLECT) ✓161

**META TECHNOLOGIES CORPORATION**
26111 Brush Avenue, Euclid, Ohio 44132

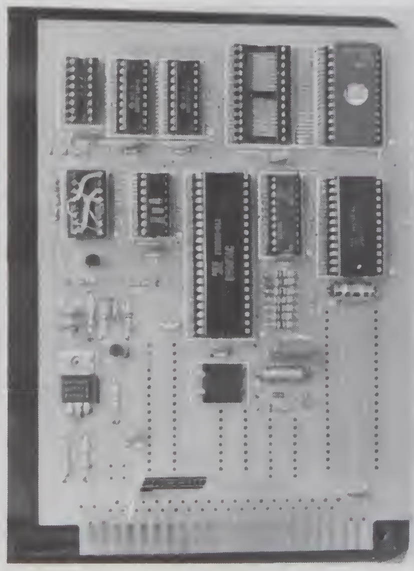
801010
TRS-80 is a TM of Tandy Corp.
PLAIN JANE is a TM of MTC.

cross-assembler for 6802 program development and HUMBUG ROMs for other 6800 systems.

Star-Kits, PO Box 209, Mt. Kisco, NY 10549. Reader Service number 484.

## 8085AAC Controller

Paccom, 14905 N.E. 40th St., Redmond, WA 98052, has recently introduced the 8085AAC controller. It includes a CPU card with 1K RAM, 1K PROM and 1K EPROM memory, programmable I/O, 44-pin edge connector that allows configuration to any bus structure and a 20 mA asynchronous port. The CPU card provides area for custom wire-wrap design or user-defined interface circuitry. Price is $179.95 (assembled), $149.95 (kit). Reader Service number 481.



*Paccom's 8085AAC controller.*

## TRS-80 Printer/Memory Expansion Module

The MT-32 is a new printer/memory expansion module for the TRS-80. The unit can add 16K or 32K of dynamic RAM to your basic 16K machine without a full-blown expansion interface. The module also contains circuitry to drive the MT-80P dot-matrix printer or any other Centronics-compatible printer.

The 3 × 7 × 16.5 inch module sits under the CRT and is available with no RAM ($99.50), 16K RAM ($159.50) or 32K RAM ($199.50).

Microtek, Inc., 9514 Chesapeake Drive, San Diego, CA 92123. Reader Service number 480.

## Eight-Inch Disk Drive

The MS-800 is a new eight-inch disk drive compatible with TRS-80 Models I and II, Apple II and S-100 systems. The MS-800 has a capacity of 77 tracks, 26 sectors per track, 128 bytes per sector—for a total of 256,256 bytes. It features a data transfer rate of 256,000 bits per second and also has a track-to-track access time of 10 ms. The drives are powered independently of the systems, and each drive is completely assembled and tested. The price range of $995–$1595 includes all hardware (such as controller and CP/M, depending on system configuration), software and documentation.

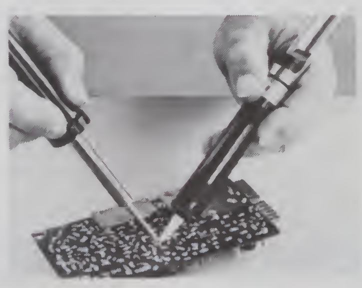
Matchless Systems, 18444 South Broadway, Gardena, CA 90248. Reader Service number 475.

*Matchless Systems' MS-800 disk drive.*

## Desolder Pump

The DSP-1 desolder pump features all-metal construction with precision components and compact size for easy one-hand operation. Suction is precisely regulated for efficient solder removal without damage to delicate circuitry. Self-cleaning on each stroke, the DSP-1 is quickly disassembled without special tools for maintenance or repairs. The Teflon tip can be easily replaced. Price is $9.95.

OK Machine and Tool Corporation, 3455 Conner St., Bronx, NY 10475. Reader Service number 474.



*OK Machine's DSP desolder pump.*

## Interactive Video Interface

The CAVI (computer-assisted video interface) Model 400 is a single board video tape controller for Apple II microcomputers. The system hardware/software permits precise video tape positioning by counting pulses from the control track of the tape. The interface contains a video/audio switcher to allow alternate display of computer-generated or taped video on a single monitor. The system will control industrial-type VHS, Beta and ¾-inch video recorder/players. No modifications to the computer or recorder are required.

BASIC software is included on disk to allow you to search to the beginning of a video scene and play until the end of that scene. Starting and ending frame numbers of each scene may be saved to the disk for future reference. An advanced computer-assisted instruction (CAI) software system is available on a separate disk. The Instructor allows you to create and modify CAI lessons and video tape logs. The Model 400 is $495; the Instructor lesson authoring software is $295.

BCD Associates, Inc., 1216 N. Blackwelder Ave., Oklahoma City, OK 73106. Reader Service number 476.


*BCD's video interface package.*

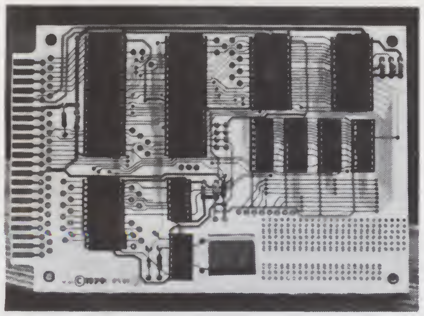
## Exorciser-Compatible 64K–256K Memory Board

The Pachyderm is a dynamic RAM memory board for the Exorciser bus which packs from 64K to 256K bytes, plus parity, on a single 9.75 × 6 inch card. Other features include 5 V battery backup, memory mapping and write protect in 2K increments, custom memory mapping using a PAL (programmable array logic) and refresh during non-RAM cycles. Because of this refresh approach, time-critical I/O operations will not be interrupted by refresh requests. Price is $975 for 64K × 9, and $500 for each additional 64K × 9.

Novex, Inc., PO Box 3006, Gaithersburg, MD 20760. Reader Service number 478.

## M-80 Single-Board Microcomputer

The M-80 is a single-board microcomputer that has a Z-80 CPU, sockets for 2K/4K of PROM, 2.1K of RAM, 16 flexible I/O lines and a system clock. The board also provides a breadboard area and 12 decoded address strobes for easy customizing. The 4.5 × 6.5 inch board was designed for test equipment, smart peripheral controllers and dedicated control and processing applications. The board may be



*Miller Tech's single-board microcomputer.*

mounted in a card cage or by standoffs.

Two software packages that use serial I/O for communications are currently available. A powerful monitor contained in a single ROM enables you to dump or enter data into memory, set breakpoints, control I/O lines or download programs from another computer. An integer BASIC provides 30 functions and commands and permits calling machine-language routines. Prices are $28.50 for the bare board, $69 for a kit and $185 for a fully assembled and tested board.

Miller Technology, 16930 Sheldon Rd., Los Gatos, CA 95030. Reader Service number 485.

---

## 1800 High-Speed Matrix Printer

The CDP18S050 is a high-speed dot-matrix line printer that features 340 cps bidirectional print speed, Centronics-type parallel interface and built-in self-test and diagnostics display. Compatible with all RCA COSMAC development system models, this printer can also be used with any system having a Centronics-type parallel interface. It offers throughput speeds of 200 lines per minute at 72 characters per line or 300 lpm at 40 cpl. The printer character font is a $7 \times 7$ dot matrix and includes a set of 96 ASCII plus 32 commonly used international characters.

The CDP18S050 features a long-life printer head designed to print $3 \times 10^8$ characters, or approximately one year of normal operation, and is designed for easy replacement. The built-in diagnostics display allows you to immediately determine the nature of the problems as they occur. Price is $2995, available at 115 volts, 60 Hz, or 220 volts, 50 Hz.

RCA Solid State Division, Box 3200, Somerville, NJ 08876. Reader Service number 477.

*RCA's CDP18S050 dot-matrix printer.*

---

## Port Switching Device

A transfer switching device from Inmac (Dept. 1025, 2465 Augustine Drive, Santa Clara, CA 95051) facilitates easy port switching between CPUs, modems and terminals, and includes a free null modem for circuit compatibility. The T-Switch permits you to switch to 24-signal lines without switching all cables. An all-purpose asynchronous null modem—generally not present in terminal and CPU cabling—is included free with each T-Switch and ensures compatibility between communicating devices.

The T-Switch has three A-800 series 25-pin female connectors. Pin one, common to all connectors, is used as system ground and is not switched. The other 24 pins permit the transfer of 24 digital data lines between devices. Price is $175. Reader Service number 479.


*Inmac's T-Switch.*

*Edited by Dennis Brisson*

# NEW SOFTWARE

---

## TRS-80 Telecommunications Program

SMART80C is the first cassette-based smart terminal software for the TRS-80. It permits the transfer of BASIC programs between the host computer and the cassette storage device and also permits the transfer of source code files. SMART80C recognizes the automatic buffer open/close codes transmitted by another SMART80C series program. Program downloading from Forum-80 bulletin boards is also accomplished automatically.

Additional features include software selection of half- and full-duplex, plus the ability to transfer text or messages created by either The Electric Pencil or Scripsit. The program will also automatically send messages to bulletin boards using the standardized block or 16-line message format. It is designed for use with the Microconnection modem.

The MicroPeripheral Corp., Box 529, Mercer Island, WA 98040. Reader Service number 498.

---

## North Star Business Software

Integrated business application software packages have recently become available for use with the North Star Horizon computer system.

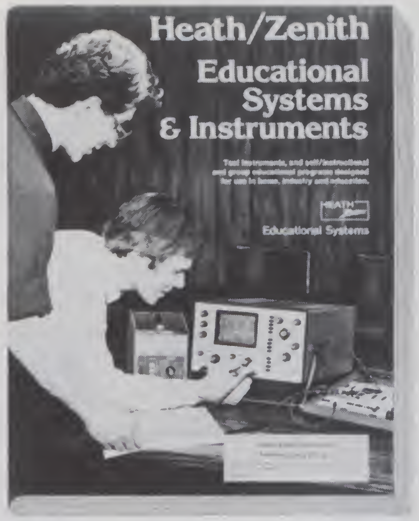
General Ledger is a complete program that allows you to maintain general-ledger accounts based on inputs such as checks, bank deposits and journal entries. It features Financial Reporting, which allows users to define dollar precision, use multiple columns, define sub- and grand-totaling and carry totals forward to other statements. With Accounts Receivable, you can establish and maintain up to 1500 customer accounts. You can retain credit limits, year-to-date sales, last year's sales and date and amount of last invoice and payment. Accounts Payable establishes and maintains up to 1500 vendor accounts and includes flexible controls for printing checks, remittance notices and reports. Each package can stand alone or be used in combination with other packages.

North Star Computers, 1440 Fourth St., Berkeley, CA 94710. Reader Service number 491.

---

## Phonetic Speech Synthesis

Speak Up Software provides phonetically synthesized speech for LPC (linear predictive coding) systems. You can create custom speech




*Heath's educational programs and test instruments catalog.*

with Speak Up Software by using the TI Speak and Spell, the SP-1 interface from East Coast Micro Products for the 6502 microprocessor or the Speak-2-Me-2 from Percom Data Company for the TRS-80.

It utilizes phonetic synthesis to allow you to generate words in the English language, as well as foreign languages. The system can be used for educational and home applications, as well as for game responses. Price is under $170.

Speak Up Software, 6710 Forest Bend St., San Antonio, TX 78240. Reader Service number 488.

---

## Cassette Pascal for the Apple II

Dynasoft Pascal is a cassette-based program development system available for the Apple II computer. This compact p-code implementation for a Pascal subset is intended for cassette-based microcomputer systems that cannot support full-scale implementations such as UCSD Pascal.

The package includes a compiler, interpreter and a line-oriented editor, occupies approximately 8K bytes and will run on a 16K Apple II or Apple II Plus. Full support is provided for both low- and high-resolution graphics. Price is $50.

Dynasoft Systems Ltd., PO Box 51, Windsor Junction, Nova Scotia, Canada B0N 2V0. Reader Service number 487.

---

## Free Heath Catalog

A free, full-color, 40-page catalog describing educational programs and test instruments for schools, industry, government and self-instruction has recently been published by Heath Company, Dept. 350-370, Benton Harbor, MI 49022. This 1980 edition details course information on 17 complete self-instruction and group instruction college-level programs in electronics, microprocessors, automotive and computer programming. Information on experimental trainers for laboratory sessions is also supplied. It also features product descriptions and specifications on more than 40 available test instruments, including oscilloscopes, power supplies, chart recorders, signal generators and TV service instruments. Reader Service number 473.

---

## TRS-80 Debugging Program

Boss 2.1 is designed to aid in creating and debugging BASIC programs. This utility allows you to trace the program flow, single-step the BASIC program, observe the conditions of variables during program execution and push your BASIC program on the stack or pop it off during program development. It operates with the following disk operating systems—TRSDOS 2.3, NEWDOS 2.1, UTOS 3.0 and NEWDOS/80.

This program for the 16K TRS-80 will operate with either Level II BASIC or Disk BASIC. It will automatically relocate itself to the top of memory for larger machines and will load below any other machine-language programs that you have in memory. Price is $29.95.

Soft Sector Marketing, Inc., PO Box 2471, Livonia, MI 48150. Reader Service 497.

---

## TRS-80 Payroll System

PR is an advanced payroll system for the TRS-80 Model II. It requires TRSDOS 1.2, a 132-column printer, a dual disk system and 64K memory. It calculates payroll for every type employee while maintaining monthly, quarterly and yearly totals for reporting purposes in multiple states. Tax tables are maintained by the users via on-line commands with no programming required. It also integrates with GL, a general-ledger system. The $129 price includes a reference manual, an installation guide, 12 programs and sample data files on an eight-inch diskette.

Micro Architect, Inc., 96 Dothan St., Arlington, MA 02174. Reader Service number 490.

---

## CP/M 2.2 for the OSI C3

Lifeboat Associates, 1651 Third Avenue, New York, NY 10028, announces the release of CP/M2 for Ohio Scientific C3 computers. CP/M version 2.2 is compatible with the original OSI CP/M disk format, and all software and data on current OSI CP/M disks can be retained. The system operates only with the Z-80 processor, which results in significantly faster disk access.

CP/M2 automatically compensates for 2 or 4 MHz CPU operation and is configured for the older, slow-stepping disk drives or the newer, fast-stepping disk drives. The system also includes a fast CP/M disk-to-disk copy routine, a thorough memory test program for the Z-80 and I/O drivers for all common OSI peripheral devices. Price is $200. Reader Service number 489.

---

## Disk Cataloging Program For PET/CBM

Now you can easily catalog as many as 140 diskettes with Disk Master, a cataloging program for the Commodore PET/CBM with a 2040 disk. The program automatically reads the directory blocks of any disk being cataloged, so no typing is involved. Each individual disk directory is stored as a condensed data file on the master directory diskette for easy recall. A cross-reference file allows specifying disks by either the disk ID or the disk name. All data obtainable via the program can be displayed or printed.

Baker Enterprises, 15 Windsor Drive, Atco, NJ 08004. Reader Service number 492.

---

## NEWDOS/80

NEWDOS/80 is an improved disk operating system that extends NEWDOS 2.1's capabilities for the TRS-80. It features new BASIC commands that support files with variable record lengths up to 4095 bytes long, mix or match drives, a security boot-up for BASIC or machine-code application programs and new editing commands that allow program lines to be deleted from one location and moved to another or allow the duplication of a program line with the deletion of the original. The program is supplied on diskette for $149.

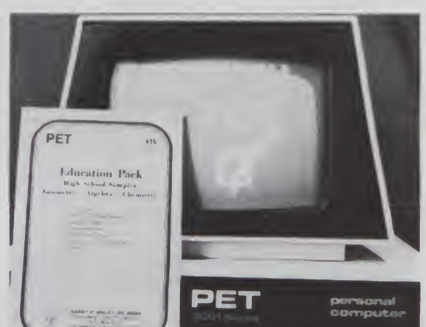
Apparat, Inc., 4401 S. Tamarac Parkway, Denver, CO 80237. Reader Service number 496.

---

## PET/TRS-80 Education Software

Eduation Pack is designed for high school math and science courses to aid teachers and students in testing three subject areas: algebra (quadratic equations), geometry (areas/volumes) and chemistry (Gay-Lussac gas law). The user may select an answer accuracy level for testing between .01 and 5 percent error. The program is available for the PET or TRS-80. Price is $15.

Harry H. Briley, PO Box 2913, Livermore, CA 94550. Reader Service number 495.




*High school test questions for PET and TRS-80. (Photo by Rodger Johnson.)*

# LETTERS TO THE EDITOR

## Editorial Call to Arms

As an Apple owner by avocation and microcomputer researcher by vocation, I found your editorials filling a void in the pages of the microcomputing establishment by encompassing a very real, if not altogether frightening, picture of the erosion of the dominance in the world market of the American industrial community at large and the microcomputing community specifically. Even though the American manufacturers will become more competitive due to such entrants as Hewlett-Packard and IBM, the industrial atmospheres in such countries as Japan will show ours to be nothing but a smog bank. As you so aptly stated, the Japanese have proven themselves to be intelligent, hard working and very clever. These attributes, coupled with a sophisticated marriage between government and industry, form an enviable environment.

Japan is not the only one, as other countries are taking a stab at it too. Two engineers I work with recently purchased the Sinclair ZX-80 and were both totally impressed with not only the attractive packaging (6½ × 8½ × 1½ inches @ 12 oz.), cost ($203, including tax and shipping) and written support (a 128-page guide to computing and an offer of schematics upon request), but also with the extreme power of the unit.

As I read your editorials, a fighting spirit encompassed me and forced my hand to thank you for "holding up your end of the system." If only American industry would do the same.

**John H. Crichton**
**New Vernon, NJ**

Your October editorial in *Kilobaud Microcomputing* is going to be remembered as Paul Revere's cry two centuries ago. But it is not going to be heard by the moguls at Detroit. They knew, you knew, I knew, everybody knew what was going to happen, but they were still unprepared, and were caught open-mouthed. The Japanese are coming quicker and better prepared to take over the electronic industry in the field of computers, and no one will do anything.

Many of us also agree 100 percent with you about manufacturers making computers for games. What a silly way of doing things! Thanks for yelling and hollering. Unfortunately, nobody seems to care.

**F.S. Loaiza**
**St. Petersburg, FL**

Your Publisher's Remarks in the October issue are right on target. I'm a frustrated businessman/consultant/investor with experience in small-to-fairly-large businesses, banking, insurance and rental property management. I don't wish to become a programmer, although circumstances are forcing me to become one in self defense. It's a most frustrating experience, not very rewarding and a great waste of my time.

As I have encountered the subject of computing over the past 25–30 years, I've experienced nothing much but frustrations. Most of the hardware is over-sold, and the software is overblown! For example, I thought my TI 99/4 would be an interesting and versatile system for use at home and a learning experience for me and the others in the household. It turned out to be another example of high-priced junk, so far as I'm concerned. It now resides at the children's school, where it can serve a useful purpose in introducing the students and faculty to small computers.

I have since acquired an Apple II Plus and am much happier, but still somewhat disappointed in the amount of programming or tinkering with programs I have to do. I'm quite willing to pay for off-the-shelf programs to run on my Apple *without* my having to modify them. Seems to me, though, that so far what I've seen does require some modification to make it run well.

**Evans Harrell**
**Marietta, GA**

## Sorcery Repetition

As a Sorcerer owner, I was most interested in Ernest E. Bergmann's smart terminal program in the July issue ("Use Your Exidy as a Smart Terminal," p. 142). It was quite well done, and with a few more "hooks" in the code it should interface to both the BASIC and Word Processor Pacs.

There is, however, one part of the code that may cause problems in certain situations. In copying the keyboard input routine, Mr. Bergmann included the instructions that loop until the key being pressed is released. This causes any incoming messages to be ignored while the key is held down. To remedy this, replace the lines 142 through 146 with:

```
NOP
EX      (SP),HL     ;
EX      (SP),HL     ;THIS NOP AND SIX SWAPS
EX      (SP),HL     ;GIVES ENOUGH DELAY SO
EX      (SP),HL     ;KEYBOUNCE WON'T BE A
EX      (SP),HL     ;PROBLEM
EX      (SP),HL     ;
```

Not only will this change help fix the problem, but it also gives the Sorcerer key-repeat! Note that altering the value loaded into HL in line 72 will alter the rate of repeat.

If any other Sorcerer owners are interested, I publish a newsletter called "TSUNAMI," which is free for the asking (SASE requested).

**Joseph R Power**
**124 Cedar St. #5**
**E. Lansing, MI 48823**

It is indeed true that if you are typing while there is incoming material, some of the incoming material might be lost. The fix that I suggest is inserting a CALL INPIFR in the area specified; you also might consider a similar insertion for the REPET loop.

**Ernest E. Bergmann**
**Bethlehem, PA**

## Bigger Is Better

In "CP/M Is for Me" (August 1980), Ken Barbier inadvertently brings up a point that I tried to make in my Discus I article in *Kilobaud Microcomputing* for November 1979: the vast advantage of the eight-inch floppy over the five-inch version. After all of his deleting and packing, Ken has 46K on the disk to play with. Now, that sounds like a lot, but if he were writing assembly-language programs, which he says is his major computer activity, 46K wouldn't go very far. Even a medium-sized program would eat that up quickly.

At first glance, the 240K capacity of the eight-inch floppy would seem to give it a 3 to 1 advantage over the five-inch disk. However, if you take into account the disk space available after storing the programs that Ken considers essential (32K), the eight-inch disk has 208K available for storage (240 minus 32), and the five-inch disk has 46K (78 minus 32), which gives the larger disk a 4.5 to 1 edge. Add to this the greater seek speed of the eight-inch disk drive and the relatively modest increase in cost over its smaller brother, and you can see why I advocate the eight-inch floppy for serious computerists. I am not claiming that the eight-inch disk is best for everyone, but just wanted to emphasize this point for potential disk purchasers to consider.

**Rod Hallen**
**State Dept.—Accra**
**Washington, D.C.**

Rod Hallen is, of course, correct in stating that eight-inch floppies are much more cost effective than the mini-floppies. My article was aimed at making life with a single mini-floppy drive more comfortable. If a user is going to be cramped by 50 to 60K of workspace, he will not be comfortable with a single mini-floppy drive at single density.

Since I regularly use both sizes of floppies—eight-inch at work and 5-¼ inch at

home—I find it significant that I feel more comfortable working with the mini-floppies. They don't hold as much data, so you don't lose as much in case of disaster. The price you pay is the need for more frequent backup, which isn't a bad idea in either case. The mini-floppies are easier to handle, less prone to damage and file away in a 5 x 8 inch card file box. Perhaps the optimum size is a 5-¼ inch double density.

**Ken Barbier**
**Borrego Springs, CA**

## Breakpoint Modifications

Glenn Foster's breakpoint program for the North Star Monitor (*Microcomputing*, February 1980) fills a great need. The North Star Monitor software offers a handy set of utilities, but its omission of a breakpointer left a large gap. When a program in assembly or machine language does not run properly, a breakpointer is often required to locate the trouble. Foster's subroutine can serve North Star users admirably.

However, I needed to make some adjustments to Foster's work to fit it to my version 5.0 North Star Monitor software (see Table 1).

Finally, lines 062 and 064 of Foster's listing need to be swapped. As shown (p. 129), the FLPREG routine to reverse the hi-lo bytes of the registers does not, in fact, reverse them at all, but instead leaves them just as it finds them. Swap those two lines, and then the registers will flip properly. By the same token, line 077, at address 56FC, should read "56 FO" instead of "FO 56." The first call to FLPREG at line 025 will invert these for further operations.

**Raoul Naroll**
**Dept. of Anthropology**
**State University of New York at Buffalo**
**Buffalo, NY**

I was very pleased to see that my breakpoint subroutine has been adapted to North Star's release 5.0. Since I use my Horizon primarily for program development in assembler, the breakpointer, along with an editor and assembler, is probably the most executed program on the system.

I am frankly not surprised to find that the internal addresses changed for release 5.0. This would result from the slightest modification by North Star. Ordinarily, prudent programming practices would preclude writing a routine with the dependencies found here, but for reasons discussed in the article (most importantly conservation of memory), it seemed appropriate here.

**Glenn Foster**
**Union Lake, MI**

## MUG Request

The Micropolis Users Group (MUG) is an association whose desire is maximizing the use of the Micropolis-supplied software. As part of this endeavor, we are compiling a directory of all software that runs on MDOS or Micropolis BASIC without requiring a second operating system. I would appreciate suppliers of such software informing me of their products.

**Micropolis Users Group**
**c/o Buzz Rudow**
**604 Springwood Circle**
**Huntsville, AL 35803**

## A Better Printer

The parallel interface described in Rod Hallen's article in the January 1980 *Microcomputing* ("TRS-80 Printer Interfaces: Serial and Parallel Designs") contained a small problem. The 74100 was enabled directly by the CPU. At the same time, the data strobe was generated by the 74123. Therefore, the data strobe was longer than the data enable. My Centronics 306 printer needed a longer data strobe, and the enable at pins 12 and 23 of the 74100 had to be longer than the data strobe.

I finally settled on using a .001 uF (1000 pF) capacitor between pins 14 and 15 of IC6. This generated a data strobe of about 7 us. As for the data enable for IC5, I used the other half of IC6 with 20k and a .0047 uF capacitor to create DE, which is about 35 us in length.

With these changes, the printer works fine. Also, my printer's technical manual shows the following pin assignments and indicates that they are standard:

| | |
|---|---|
| Data Strobe | 1 |
| Data 1 | 2 |
| Data 2 | 3 |
| Data 3 | 4 |
| Data 4 | 5 |
| Data 5 | 6 |
| Data 6 | 7 |
| Data 7 | 8 |
| Data 8 | 9 |
| Busy | 11 |
| Paper out | 12 |
| Unit select | 13 |
| +5 volts | 18 (I used this to power the interface) |
| Fault | 32 |
| +/−0 V sig. gnd. | 14 and 16 |

The manual also shows the various return paths, and these pins should be tied to signal ground—19 through 29. A new schematic is shown in Fig. 1.

**Eric Keener**
**Broomfield, CO**

The interface in my article worked perfectly with an RS-232 printer. I presented the parallel

*(continued on page 222)*

| Line no. (p. 129) | Item | Address | Version 5.0 Address |
|---|---|---|---|
| 003 | Command table patch | 593A | 595E |
| 009; 013 | Address fetch subroutine | 5D3E | 595D |
| 011 | Monitor error routine | 5D58 | 583C |
| 054 | Monitor's internal stack | 5EF8 | |
| 056 | Return to monitor (Change optional here) | 5700 | 571C |

*Table 1.*

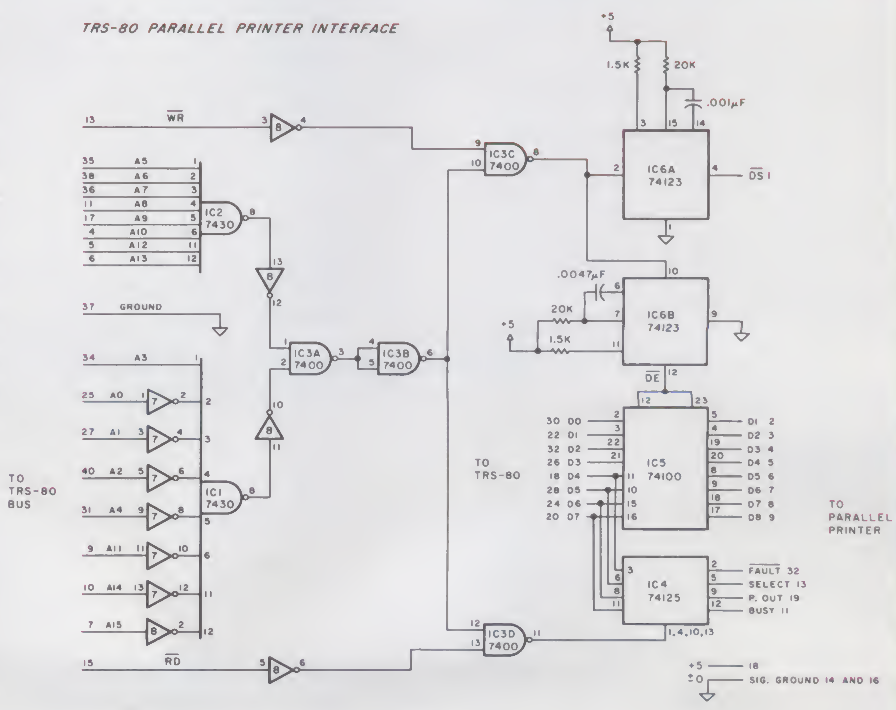



*Fig. 1.*

# 1980
# Christmas Sale
## Model I & II Software

Where Your TRS-80 Means Business —
The Best in Model I or II Programs Available Now!

### MODEL 1
**Complete Business System**

This integrated system includes Invoicing, Inventory Control, Accounts Receivable, Accounts Payable, Payroll, General Ledger and Word Processing. A complete Business System for your Model 1.

**SPECIAL OFFER**

**$299^{95}**

### MODEL II
**— Business System —**

Complete with all manuals. This is one of the best and most complete Business Systems for your Model II. Best of all it is easy to use. Enter the world of the Model II with a system that works!

**SPECIAL OFFER**

**$649^{95}**

### MODEL I
**Medical/Dental System**

Complete System — Easy to use! Now you can use your TRS-80 where you intended to use it — in your office! Give us a call for complete details on this new Complete Package.

**SPECIAL OFFER**

**Special $349^{95}**

### ★ SPECIAL ★
**Verbatim 5¼" Mini Disks**

**$24^{50}** Box (10 Per Box)

**Verbatim 8" Floppy Disks**

Double Density FD34-8000)

**$44^{50}** Box (10 Per Box)

Limit 4 Boxes Per Customer

*OFFER GOOD WHILE QUANTITIES LAST

### MODEL II
**CP/M Release 2.2**

Including Utilities and full documentation. This is the CP/M designed for the Model II.

**SPECIAL OFFER $169^{95}**

Including CBASIC-2 **$229^{95}**

CBASIC-2 ONLY **$79^{95}**

**Before You Buy Any Software Call Us First!**

### MODEL II
**Medical/Dental System**

Same as above with much more! This System also includes our computer-Based Patient History System. THE BEST!

**Special $699^{95}**

## ★ Christmas Gift
**5 Free Data Diskettes with each Complete Business System**

★ All Programs Supplied on Diskette ★

# The Noise Can Be Deafening

A buzz of background conversation is punctuated by ice tinkling occasionally in a glass. Suddenly there's a gunshot, a scream and general uproar. Sirens, a screech of tires, breaking windows follow.

A late-night movie? Perhaps a real-life tragedy? No, it's only an electronic sound enthusiast creating a computer-controlled sequence of effects.

In this issue, we will take a look at some of the latest unusual and exciting developments in the field of electronic sound. Once the sole province of university professors, electronic music is now an area where microcomputer users are becoming enthusiastically involved.

Apple users will have an opportunity to explore a new programmable sound generator made by General Instrument. They will be able to build Robert Urschel's sophisticated interface and create music and sound effects with this software driver . . . and listen to a little of "The Maple Leaf Rag."

North Star users will have two chances to create electronic sound, using the GI device with hardware devised by Steve Leibson, and also by putting a new Texas Instruments integrated circuit to work. In "Computer Music the Easy Way," Steve Marum gives us a detailed look at the capabilities of the latest TI sound chip, and makes it play J. S. Bach.

Single-board computers have the elegance and simplicity demanded by music programs, and D. Kupke treats Superboard owners to computer sound with a mere dollar's worth of parts. The KIM, the first micro to play music, is now the first micro to display it as fast as you can play it, using Peter Bendix's Music Transcriber.

Owners of both a synthesizer and a TRS-80 can avail themselves of their combined power with a computer-to-synthesizer interface—playing more J. S. Bach. And those of you without a synthesizer need only build a modular voltage-controlled unit, in this pair of construction articles by Dennis Bathory Kitsz.

There's Terry L. Mayhugh's look at connecting the Votrax speech synthesizer to the SWTP 6800 computer, a short history of electronic music, and a rollicking look at the secret life of a harried modern composer.

So take a look at exactly what the microcomputer user is doing, making that weird music so late at night.

# A Short History of Computer Music

*With advances in this field occurring every day, it appears that computer music is here to stay.*


*Dennis Bathory Kitsz*
*Roxbury, VT 05669*


Nearly 20 years ago, digital computers first became available to a selected few composers, artists and university instructors. Bell Laboratories and IBM participated in early experiments simulating musical instruments and the human voice. In Paris, the Centre Pompidou was compiling a vast library of recorded, analyzed and cataloged sounds, prepared over many years, and made available to composers and acousticians. Nonesuch Records sought out and commissioned composers to create new works in the electronic medium.

Common features link these elements, the most obvious of which is the electronic nature of the explorations. Another is their unique lack of popularity and public acclaim. The computer experiments, when acknowledged at all, were usually viewed with wry smiles and a bemused exchange of glances over these curious intellectuals gathered together to create bleeps, bloops and some strained versions of computers "singing" short tunes.

Attitudes haven't changed much. Parisians still see the Paris library as one more obvious manifestation of the bureaucratic and cultural mistake most of them consider the entire Centre to be, with its external, gaudily colored heating pipes and glass-enclosed escalators. Nonesuch Records was acquired by a conglomerate, which immediately began axing employees who had tried to secure recordings of experimental electronic compositions. At the close of the 70s, money was in and what the executives saw as specious art was out.

But something new is happening in the field, something stimulated by amateurs experimenting in their electronic backyards. The weird bloops and bleeps of the past are now being heard in living rooms that otherwise are perfectly respectable, and musicians who have never been to a dreadfully serious "new music" concert are writing with and for microprocessor-controlled music boxes.

The result of this renewed interest is not only the publication of new books and magazines on the topic of electronic music, but also a confusion of the old, comfortable terms and definitions by which composers could identify the me's and the them's.

### What is Electronic Music?

In the past, electronic music could be divided into several easily recognized types:

*Concrete music.* This term arose out of the need to separate all-electronic music from that which used acoustic elements, however they might be manipulated or transformed by a composer.

*Synthesized music.* Any music produced by oscillators and other audio-type (analog) circuits. The earliest synthesizers amplified the beats produced by radio waves of different frequencies (known as "birdies" by radio buffs). These sounds were used as early as the 1930s by composers Olivier Messiaen and Darius Milhaud. Even Debussy imagined the sound, and some of his music has occasionally been performed with electronic assistance.

*Computer music.* Composers of computer music are more insistent about this differentiation than other musicians. Specifically, computer music is fully electronic sound in which the actual waveforms, envelope (electronic equivalent of an embouchure), volume and so on have been calculated and created by a computer under the composer's direction. Analog processing by such instruments as synthesizers is scorned as imprecise.

As a whole, electronic music used to be created by "other" musicians—the European-trained aesthetes whose recordings bore badly surrealist covers and labels stamped "imported" to help them sell in the American commercial market, like some sort of otherwise unappetizing cheese. In Germany, the solemn and passionate Karlheinz Stockhausen created hours-long works of radio noises and electronic squeaks and warbles mixed by painfully patient technicians. America has its proselytizers of the electronic revolution in those such as Milton Babbitt, whose sincerity and discipline are offset by a used-car-salesman-like penchant for selling his style of music in endless streams of films and lectures.

### "Serious Music"

This trend seemed to be balanced in the world of "serious music" by Zen-influenced minimalists whose guru was John Cage. Cage is a composer whose more notorious experiments included peeling carrots in front of a microphone and directing a performance during which a piano, the only instrument in sight, remained entirely unplayed.

The first microcomputer to play an integral part in musical composition and performance was the KIM-1, used by Cage's sometime-disciple David Behrman, who modestly refers to himself as a programmer rather than a composer. Both men approach music similarly. Neither Cage's nor Behrman's writing is exactly "foreground" music, having a trance-like quality that belies traditional melody, harmony and rhythm. Even the texture, with its electronic elements, owes little to either the concert hall or the popular stage.

In the avant-garde arts, Cage had compatriots like Charlotte Moorman, best known by the public for her arrest in the 1960s as the "topless cellist" during a performance of Nam June Paik's "Opera Sextronique." Moorman's cause celebre is a yearly celebration of contemporary arts and artists in New York City, which this year drew over 500 participants. The significance of this event lies mainly in the changes within the arts, particularly music, that can be seen and heard there.

These changes have recently revealed an

## DISCOGRAPHY

### Concrete Music with Electronic Sound

• Edgard Varese, *Ecuatorial*. For instruments and two Ondes Martenot. 1934. On Nonesuch H-71269, with Offrandes, Integrales and Octandre.

*Ecuatorial* harks back to almost a lost era of music, using a few instruments in sparse settings, but still painted in romantic hues. The Ondes Martenot was a monophonic electronic instrument invented in the 1920s. It has a rich, sweet sound, and for many years was a favorite of European experimental composers.

• Karlheinz Stockhausen, *Gesange der Junglinge*. For child's voice and electronic sound. 1956. On Deutsche Grammophon 138811, with Kontakte (1959) for percussion and electronic sound.

"The Song of the Youths" is a remarkably listenable piece. Using the electronic music studios of the West German Radio, it, like *Ecuatorial*, has a rich sound that may in part be attributable to the use of vacuum tube electronics. The child's voice, singing lines from the prophet Daniel, has a disarming sweetness.

• Iannis Xenakis, *Electro-Acoustic Music*. Nonesuch H-71246. 1957–1962.

Xenakis is one of the most trying composers for the average listener's ear. In this group of four works, "Bohor I" in particular (mutated from the sounds of bracelets and other jewelry) presents a virtually impenetrable sonic wall. The original version of "Concert P-H" was composed for the 1958 Brussels World's Fair, and was performed (to both public acclaim and derision), using 400 loudspeakers.

• Gyorgi Ligeti, *Volumina*. For organ. 1962. On Candide CE 31009, with Aventures, Nouvelles Aventures and Harmonies.

*Volumina* contains no electronic sound, but is vastly colored by Ligeti's experiences at the Cologne studios where the decade's most important electronic works were produced. The line between acoustic and concrete/electronic sound blurs in works like this one.

• Karlheinz Stockhausen, *Opus 1970*. For electronic sound and live performers. Deutsche Grammophon 139461.

This recording demonstrates what many consider to be the beginning of the decline of European electronic composition. Fragments of Beethoven's music are combined, via electronic manipulation, with the partly improvisational performances of pianist, violist and percussionists.

• John Cage and Lejaren Hiller, *HPSCHD*. For two harpsichords and electronic sound. 1969. On Nonesuch H-71224, with Ben Johnston String Quartet No. 2.

*HPSCHD* is almost garish in its approach, with both instruments and electronics very present in the recording. Cage and Hiller explain the premise of this composition—the use of chance elements and Mozart's music—very seriously, but the piece is more often very funny. The first pressing contained a computer printout called "Knobs," unique to each copy of the disk, which encouraged the listener to join in the performance of *HPSCHD* by altering the recorded sound with the treble, bass and volume controls for each channel as the stereo disk played.

• William Bolcom. *Black Host*. For organ, percussion and tape. 1967. On Nonesuch H-71260, with William Albright Organbook II.

Traditional drama began a return to combined concrete and electronic music. *Black Host* includes a powerful organ in traditional guise, percussion and a schizophrenic tape of electronic and natural sound, for a sometimes humorous and very striking work.

• Eric Salzman. *The Nude Paper Sermon*. For actor, Renaissance consort, chorus and electronics. 1969. Nonesuch H-71231.

Salzman has created a wonderfully funny piece in which the diverse elements create a theatrical collage. The Renaissance consort and chorus and electronics are brilliantly integrated into a texture of alternating delicacy, irreverence and bombast. The work is showing its age (strongly 1960s in its political and artistic approach), but remains witty and well-conceived.

• George Crumb. *Black Angels*. For electric string quartet. 1970. On Philips 6500881, with compositions by Raxach and de Leeuw.

Although *Black Angels* is produced with purely acoustic instruments, the electronic amplification coupled with the composer's style often present a striking illusion of synthesized sound. In particular, the third section is characterized by the peculiar romantic sparseness first heard in the string music of Bela Bartok, but with the electronic influences of Xenakis.

### Synthesized Music

• John Cage. *Fontana Mix*. 1958. On Turnabout TV 340465, with compositions by Berio and Mimaroglu.

This is a version for magnetic tape alone of a piece of Cage's pioneering "chance music." It is not a listenable piece, but after repeated hearings develops a kind of coherency that belies its roots in somewhat (and unscientific) random events.

• Morton Subotnik. *Silver Apples of the Moon*. Nonesuch H-71174. 1967.
• Morton Subotnik. *The Wild Bull*. 1972. Nonesuch H-71208.

*Silver Apples* is probably the first electronic composition that does not betray its synthesized origins, yet is fully listenable. Subotnik worked to produce a coherent, rich and subtly textured whole. *Silver Apples*, written on commission from Nonesuch Records, was also the first electronic work written specifically for disk. The *Wild Bull* demonstrates, on the other hand, extending rich texture and electronic picture-painting nearly to the breaking point; it too is not a difficult work to hear, but its tricks and images quickly wear thin.

• Charles Wuorinen. *Time's Encomium*. 1969. Nonesuch H-71225.

This work won the Pulitzer Prize for composition, the first electronic work to do so. Like Subotnik's, it has a richness quite different from the works of European heritage. Although not as charming as the Subotnik piece, it is still eminently listenable.

• Walter Carlos. *Switched-On Bach*. 1968. Columbia MS 7194.
• Tomita. *Snowflakes Are Dancing*. 1972. RCA ARL1-0488.

Both these recordings are not "electronic compositions," but rather realizations of classical works using synthesized sound. The results are detailed and overly sweet, but make a popular case for the musical validity of synthesizers. Moreover, the Carlos recording was the first "classical" disk to earn a gold record for high sales.

• Synergy. *Electronic Realizations for Rock Orchestra*. 1975. Passport PPSD-98009.

This recording, as contrasted with the Carlos and Tomita efforts, is worthwhile in its demonstration of the negative results of "oversynthesization." It is a collage of synthesizers, frequency and phase shifters, phasers, digital delay and myriad electronic enhancements. The result, though far from chaotic (and just as far from skilled composition), is no more listenable than the most harsh Xenakis or Stockhausen electronic works.

### Computer Music

• Charles Dodge. *Earth's Magnetic Field*. 1970. Nonesuch H-71250.

With the assistance of three scientific colleagues, Dodge produced this piece given inspiration by the Bartels Kp graphs of the earth's daily fluctuations in magnetic activity. This sterile scenario of scientific consultations and calculations results in a surprisingly delicate world of electronic plunks and angelic arpeggios, though it is necessarily limited by the extremely difficult task of creating complicated polyphonic sound via computer.

• *Computer Music*. Works by J. K. Randall, Barry Vercoe and Charles Dodge. Nonesuch H-71245.

Though the works themselves are only fair, an interesting aspect of this record is the use of different programming languages created for the composition of music: MUSIC IV and MUSIC IVb, FORTRAN MUSIC IVb and MUSIC 360. Composer Vercoe was the author of the MUSIC 360 program for the IBM/360 computer.

Very little pure computer music is currently available on records, due both to the economics of record production and the difficulties of composing thoughtfully in the medium. Interested readers can search the electronic music pages of the *Schwann Record and Tape Guide* (available in record stores and departments), or can send for a catalog of recordings from Composers' Recordings, Inc. (CRI) in New York City, or 1750 Arch Records, Box 9444, Berkeley, CA 94709.

An interesting demonstration/explanation of synthesized music is still available on Nonesuch Records. Called the *Nonesuch Guide to Electronic Music*, and issued in 1970 (#HC-73018), it presents each of the elements of traditional electronic composition, a detailed booklet, and a sample (and innocuous) composition called "Peace Three."

—*D. K.*

interesting inversion of trends: Younger, classically trained composers are beginning to shun the electronic or synthetic sound, just as the general public is hearing more of it in popular tunes, commercial jingles and films.

The expansive acoustic scores of Philip Glass and Steve Reich were the first indications of this curious reversal; Reich's percussive works often evoke thoroughly non-electronic tribal rhythms.

These popular aspects of non-acoustical music (if any music can be so described) began with inventor Robert Moog, whose portable synthesizers started to appear ten years ago in major rock bands. Moog's larger machines were still studio pieces, but the portable ones were followed quickly into the marketplace by Arp, Aries, Buchla and a dozen smaller and soon forgotten manufacturers.

### Along Came Carlos

Hard-core electronic classicists withdrew to the safety of universities and inner-city lofts when *Switched-On Bach* also made its tumultuous appearance a decade ago. Walter—now Wendy—Carlos brought an incredible sonic virtuosity to what had been popularly viewed as a cold, esoteric medium, and his record reached the top of the classical charts. It was classical music's first million seller.

Stockhausen, Babbitt, Cage and lesser-known academics such as Charles Wuorinen, Morton Subotnik and Vladimir Ussachevsky suddenly became elders in the field, since their works bore the unmistakable and uncomfortable heritage of Arnold Schoenberg and his increasingly discredited 12-tone style of composition.

Schoenberg, a turn-of-the-century German romantic composer, broke violently with previous stylistic canons by proposing that all tonality—fundamental to Western music for more than a millenium—was useless to the future of the art. Although his work now sounds quaintly 19th-century, it gave rise to more than 50 years of internecine unpleasantness in the musical artworld. Finally, the computer, with its ability to generate seemingly random patterns of sound under the beneficent ear of a composer, was seen as a perfect vehicle for proving Schoenberg's thesis.

The public, and even a great proportion of artists and musicians, had been thoroughly unconvinced about 12-tone music's validity. A few years ago, in fact, the musicians of the staid Berlin Philharmonic so enraged composer Lucas Foss (with their unceremonious whooping and grunting during a performance of one of his less listenable works) that he publicly took them to task in

*(continued on page 30)*

*Bio: David Gunn is a composer/writer/musician with a long list of "almosts" to his credit. He has toured with modern dance companies before they became famous, he was almost the keyboardist for the first touring of "Jesus Christ Superstar" and he almost had his first screenplay made into a zany feature-length motion picture. He has been called a "composer's composer," but unfortunately only be a few pen pals at Bellevue State Hospital currently undergoing electro-music therapy.*

# Electronic Music

*Where it has been, where it is going, and why I'm headed the other way.*

**By David Gunn**

Before I start this article, I'd like to get a couple of things straight. First of all, I'm the composer, not you. The fact that you're reading this magazine might not mean you don't know beans about electronic music, but I'm betting it does. Real music-oriented people read real music publications like *Stereo Review, Rolling Stone* or the *Musical Quarterly*—not this stuff with its pseudo-elitist attitudes toward anything that plugs into a wall socket.

Another thing. I'm getting paid significantly less than what I suspect I'm worth. This isn't unusual in an era of malevolence towards modern musicians, but when I see otherwise useless engineers pulling down $800 a week just for producing a wristwatch with a built-in thermometer—well, it makes me sick.

This sickness more often than not tends to permeate much of what I write. So if I seem a little testy, it's due in no small part to the techno-electronia this periodical helps promulgate.

Hey, don't get me wrong—I'm not dead-set against electronics. I may not allow any disk in my home floppier than a frisbee, but I do own a calculator. I've even got a real electronic synthesizer. Not only *that, I once* studied computer music in college; even bought a record of it for a friend.

So it's not as if you're reading the blusterings of a dilettante with an IC chip on his shoulder. No sir. I got repute (see bio), which is a lot more than can be said about today's computer music.

The real problem is that when most of you folks read the words "computer music," you get such auditory images as the beeps, whistles and silly mechanical ululations emanating from the lower digestive tract of Robbie the Robot. Don't be embarrassed, because in this case the stigmatism is justified. Noises that a real composer—schooled in real harmony and theory classes—would be ashamed to admit came from putting felt-tip pen to paper are instead imperiously explained away by the computer programmer as "randomly generated patterns of acoustical events and stuff." Baloney.

See, progressive and literate composers—including me—were repeatedly told that it's a neat trick to turn an acoustical event into a musical one. Like George Antheil's 1924 "Ballet Mechanique," which incorporated a prop engine from a Ford Trimotor airplane, or a piece I wrote last year in which a young lyric soprano was unfortunately decapitated by a falling piano lid. Both acoustical events became musical ones, never mind what the myopic critics had to say about the latter.

But now we get these shiny new computers trying to make avant-garde inroads by randomly generating previously acceptable musical events back into acoustical ones—all for the sake of inscrutable techno-electronia. This is progress?

Ah, but you contend that randomly generated patterns can't be all bad. Well, think again: traditional rules of order are being inconsiderately given an electronic kick in the pants.

If you still don't grasp the chaos this can produce, just imagine a randomly prepared skillet dish, or perhaps a randomly performed tonsillectomy (and that's *your* throat the tonsillectomer is diddling with, bud). Randomly generated computer music is even more insidious because most people—like yourselves—fail to understand how inherently bad it is. You tend to feel self-conscious because you don't like it—but you really don't want to be out of step with the times. Do I sound testy yet?

In a related development (distantly related, granted), ten years ago this December some college chums and I were planning a little something to celebrate Beethoven's 200th birthday. We scheduled a concert wherein 32 pianists would play his 32 piano sonatas simultaneously on stage. The gala recital fell through, however, when a stodgy administrator learned of the finale, when each piano would be shoved into the orchestra pit following the conclusion of each respective sonata.

Now tell me. How would a computer be programmed to produce a once-in-a-lifetime sonic effect like that? But enough cynicism about the past (except the Univac) and the present.

Maybe I can coax a happy ending out of this little diatribe by looking to the future, to the dreams, hopes and aspirations of modern man, to the 30 bucks I may still get for this article. Think, if you will, of a world—a happy world—free from hunger, strife and mosquitoes . . . a world in which computers cater to the utter whimsy of humankind . . . where laser-operated commodes provide dazzling light show accompaniments to otherwise banal bodily waste disposal . . . where kitchenettes are forever spic-and-span thanks to diligent tending by holographic white tornadoes . . . where musical chairs evolve from an illogical children's game to a vital element in a symphonic living room grouping. (I think I may be losing my grasp on this article's original premise, but it's too late to stop now.)

Imagine computers happily dictating how many times to fill the orange juice can to create the perfect balance of cool tap water and frosty orange beads; computers merrily and musically regulating traffic light sequences to enhance the hustle and bustle of Main Street USA during rush hour; computers competently advising us when to clean the furnace, for whom to vote, which Brussels sprouts are the better buy (none of them are, actually) and whose teeth are whiter. Computers . . . ya can't live with 'em . . . ya can't live (the music's driving me mad . . . totally out of control). Wake up, America! The future may already be . . . beep . . . tweeeeeeee . . . mmmmmmmmmmmmmmmmmmmmmmm.

*Real bio: David Gunn really is a composer, writer and multimedia artist whose compositions have been performed across the country. Most notable among his electronic and acoustic/electronic collages are "Boondock," premiered in Washington, DC, and "Bats," premiered and recorded in San Francisco. His work with the Lynn Dally Dance Company has included the premiere of "Radio Alley" in New York City and "Quizducks" in Athens, OH. Gunn's compositions are littered with questionable humor, including one calling for falling dead birds, tear gas in the audience and pies thrown at a piano. Gunn can be found at 106 Midway, Riverton, NJ 08077.*

## MUSIC GLOSSARY

**A Glossary of Electronic and Musical Terms**

**Analog**—A term generally referring to circuits where variations of voltages or currents are in proportion to (analogous to) non-electronic events. Stated simply, analog circuits "look like" the input signals fed to them, such as record grooves, which "look like" the air pressure variations made by the sounds which created them.

**Attack**—The way a sound is begun. A sudden (sharp) attack can be heard in drums, whereas a very soft attack is usually present in humming.

**Computer Music**—Composition in which *pitch*, *envelope*, *timbre*, *voicing*, etc. are created by computations of a computer. This type of music is different from that created by *analog devices*, with or without a computer's control.

**Decay**—The period during which a note dies out, such as at the release of a piano key or pedal, or at the end of a sung note.

**Digital**—This term generally refers to circuitry which transfers information by numeric calculation. Sound, for example, can be stored as arbitrary numerical patterns bearing no inherent relationship to the original sounds. Nevertheless, the sound can be created, mutated, changed or retrieved by calculation.

**Embouchure**—A musician's term for the position of the mouth on a woodwind instrument; there is no equivalent word in string, percussion or keyboard playing. The position of the embouchure can change the *timbre* of the instrument. In referring to playing techniques on any instrument, popular musicians use the word "chops," which implies an embouchure.

**Filter**—This very general term includes a vast array of electronic devices. In electronic music, a filter is used to remove selected parts of the audible spectrum from a sound. Sometimes the filtering removes all tones above a certain pitch (low-pass filter), with the effect of "smoothing" the tone's quality. All tones below a certain pitch can be removed by a high-pass filter (almost a purely electronic phenomenon), best heard in the unintended tinniness of portable radios. Filters can also remove all tones above and below a certain pitch or group of pitches (band-pass filter), which can be approximated by listening through a paper towel tube. Finally, only a single pitch or group of pitches (notch filter) may be removed, another almost purely electronic activity. The result of any of these filterings is a change in *timbre*.

**Envelope**—The electronic equivalent of an *embouchure*. It determines how a note starts (*attack*), how long it will play (*sustain*) and how it will end (*decay*), although the envelopes can be much more complicated than this simple description might imply. Envelopes are a measure of varying volume, or amplitude, of a sound.

**Frequency**—The lowest number of regular fluctuations produced per second by an unchanging note. This is the pitch of a note expressed scientifically.

**Fundamental**—The "note." Very few notes are purely on *frequency* or *pitch*, but the term fundamental refers to the lowest (and usually most prominent) of these frequencies.

**Harmonic**—A note higher than, and physically related to, a *fundamental*, produced by the same instrument, and sounding at the same time. A ringing bell can be heard to have many rich harmonics, whereas in a woodwind, these harmonics are important but more subtle. Fuzz-boxes, on the other hand, produce deliberately large quantities of harmonics. The proportion and volume of harmonics give a note its distinct *timbre*.

**Harmony**—Specifically, harmony is the simultaneous playing of several fundamental notes; however, it is generally used to refer to simultaneous notes (chords) which are "pleasant" to human ears.

**Noise**—This term derives from the random character of what is popularly called noise. In electronic music, it consists of many different, unrelated, usually random pitches, and sounds in its raw form like a gust of wind through trees or between-station hiss on an FM radio. It can be filtered to simulate natural sounds, or be used for its own sake. Natural musical instruments using great quantities of noise are cymbals, snare drums and other percussion. Noise can also be heard as part of the sound of the breath in singing, playing flute and other woodwinds, and moving a bow on a stringed instrument. Gunshots, thunder and explosions contain mostly filtered noise.

**Orchestration**—The selection of instruments used to play a piece of music. When referring to electronic music, it means the composer's selection of *voices* and *timbre*.

**Oscillator**—An electronic circuit which creates regular fluctuations of electron flow. When transformed to air motion within the normal hearing range, it sounds as a simple *pitch*. Oscillators are the basis of *synthesized music*.

**Partial**—A *fundamental* or a *harmonic*. The fundamental is the first partial, and the harmonics are numbered sequentially.

**Pitch**—A *frequency* of a note's *fundamental*. Since the fundamental is the most audible part, the note is named for this fundamental. A note whose frequency is 256 cycles (fluctuations) per second is known as middle C; one whose fundamental's frequency is 440 cycles per second is the orchestra's tuning note A.

**Polyphony**—Music containing more than one independent *voice*. The only traditional instruments that are naturally polyphonic use keyboards (piano, organ) and flat necks (guitar, lute). Producing truly polyphonic music electronically is complicated (and costly) because it requires a separate, independently-controllable signal for each voice.

**Quality**—Another term for *timbre*.

**Ramp wave**—A sound wave containing a fundamental and an equal proportion of even- and odd-numbered harmonics; the sound is buzzy. When graphed, the sound wave looks like a ramp of sawtooth.

**Sine wave**—A sound wave containing a fundamental pitch and no harmonics; the sound is "pure" but dry. When graphed, it appears as a smooth curve based on the sine function.

**Square wave**—A sound wave containing a fundamental pitch and only the odd-numbered harmonics; the sound is buzzy and reedy. When graphed, the wave appears as a group of open, connected squares or rectangles.

**Sustain**—The period of time during which a note is sounding. For example, when a clarinet is being played, it is sustained until the note is released. The sustain can be short (as with a drum), or long (a violin). Often a sustain and the decay are difficult to distinguish, as in a ringing bell.

**Synthesized Music**—Music created by electronic means, usually by using *oscillators*, *noise generators* and *filters*. This type of music is distinguished from strictly computer music by the analog circuitry used to produce it.

**Texture**—A general term referring to the collective balance of *orchestration* and *timbre* in a piece of music.

**Timbre**—The distinguishing characteristic of a note. It allows a listener to distinguish between, for example, a saxophone and a flute. The proportion of volume of *harmonics* to a note's fundamental determines the timbre.

**Triangle wave**—A sound wave containing a fundamental and only the even-numbered harmonics; the sound is warm and throaty. When graphed, it looks like a group of open, connected triangles.

**Voice**—A musical line or part. Originally, European music (the heritage of most present-day Western music) was sung. As technology and cultural forces allowed, instruments were added to these sung lines. Eventually, even in pieces which were purely instrumental, the lines of music remained known as voices.

**Voltage-controlled oscillator**—An *oscillator* whose output pitch is in proportion to an input voltage. VCOs are the stock-in-trade of analog synthesizers.

an open letter. But now the orchestral braying and bleating of atonality and its cousins has been joined by a seemingly unrelenting electronic barrage. Expensive and unresponsive performers would no longer be necessary in the brave new world of fully electronic musical writing.

The arrival of the magnificent world has been delayed, however, by the appearance of the microcomputer. Although not immediately capable of the level of speed demanded by strictly computer music—in which waveform, envelope and amplitude are generated entirely by the electronic instrument—it is very capable of directing peripheral devices with ease and precision.

Behrman's use of the KIM to control a bank of triangle-wave oscillators was a precursor of what can be expected shortly. His KIM, with its hexadecimal keypad and minimal memory and interfacing structure, produced amazingly eloquent music.

Machines like Apple, TRS-80, Challenger and PET, with their capacity for interactive, full-featured music languages, have certainly been underused for serious composing. But the advent of peripheral chips from Texas Instruments and General Instrument suggests that hobbyists and artists alike may soon be able to challenge the academics to a new round of musical show-me.

### Them Changes

The presence of inexpensive computer power will once again bring the much (and sometimes deservedly) maligned contemporary artist into the public attention. Sound, random sound, for its own sake, moves from the Zen-mystique into the commonplace. With nurturing, who can say how the art will grow?

Christoforo's fortepiano gave new life to the keyboard as a musical force, and Mozartean harmony was born. Technical improvements allowed the thunderous compositions of Beethoven.

With each advance in the trappings of the musical art has come a concomitant, yet surprising, change in the art form itself. After a quarter century of struggle, computer music may yet find its way. ■

*Dennis Bathory Kitsz is a composer, author and artist whose works have been performed in the U.S. and Europe. Of his composition for electronic synthesizer and Renaissance recorder, performed at the 12th Annual New York Avant-Garde Festival,* The New York Times *said, "Very few artists had the imagination or the encouragement . . . to come to grips with all that space . . . The effect (of the performance) was mysteriously quiescent, like some Chinese Pan." Kitsz an editorial consultant for* 80 Microcomputing *and* Kilobaud Microcomputing, *has written several articles for this computer-music section.*

# WE HAVE A FULL HOUSE


## Buy Only From a "Factory Authorized Source"

THE STOCKING SOURCE

| PRINTERS | List Price | Your Cost |
|---|---|---|
| Okidata Microline 80 | $ 800. | $600 Ask for Our Price |
| NEW Microline 82 | $ 960. | Ask for Our Price |
| Anadex Model DP-8000 or DP-8000AP | $1095. | $895 Ask for Our Price |
| Anadex Model DP-9500 or DP-9501 | $1650. | Ask for Our Price |
| Epson Model TX-80B Friction Feed | $ 710. | Ask for Our Price |
| Epson Model TX-80B Tractor Feed & Graftrax | $ 799. | Ask for Our Price |
| Epson Model MX-80 | $ 645. | Ask for Our Price |


**Ask about the gift that will accompany every printer order placed in December 1980**

## INTERFACES

- Okidata Microline 80 Tractor Feed . . $100.
- Okidata Microline 80 RS-232 Interface with 256 Character Buffer . . . . . . . . $200.
- All above Printers — Cable from Printer to TRS-80 . . . . . $ 35.
- Epson-Serial Interface & Cable . . . . . . . $ 75.
- Epson IEEE 488 Interface & Cable Specify Standard or PET Model . . . . $ 80.
- Epson Apple Plug-In Interface with On-Board ROM and Cable . . . . . . . . $110.

**ASK FOR OUR INSTANT DISCOUNT From Roy Hawthorne Talk To Bill Tokar On Applications**

**CALL TOLL FREE**
U.S.A.
1-800-521-2764
MICHIGAN
1-800-482-8393

master charge · VISA

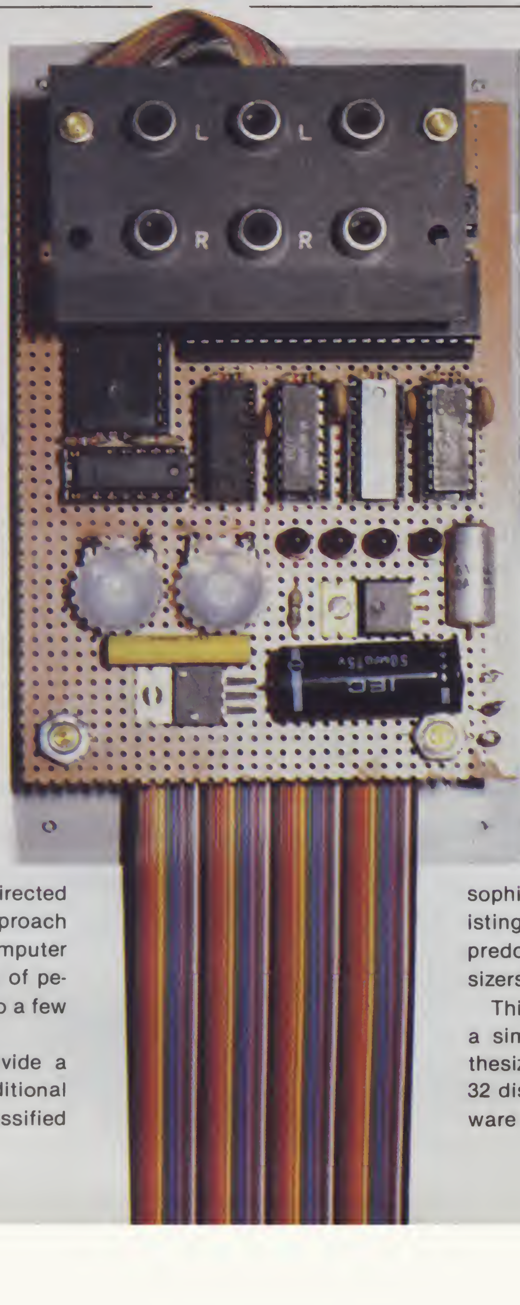
**WRITE TO:** 288

**"The Stocking Source"
23995 Freeway Park Dr.
Farmington Hills, MI 48024**

# Build a TRS-80-to-Synthesizer Interface

*With this melodious combination, you can tune in to the classical sounds of J. S. Bach.*


*Dennis Bathory Kitsz*
*Roxbury, VT 05669*


There are already a dozen commercial music boards available for personal computers. Some are very advanced and well-designed, while others are minimal noisemakers. But for composers and others serious about producing listenable sound without a large investment of cash, programming time or hardware components, present-day technology offers no real choices.

Pure computer music is out of the question. Economically, it is the least expensive method, requiring little outlay for peripheral hardware (excluding hardware needed for mass storage, which might be substantial). But for an artist or listener who depends on ease of revisions and additions, or rapid, real-time performance of more than elementary tunes, it is nearly impossible with small computers. Only highly skilled programmers could, with software alone, turn a microcomputer into a reasonable music machine.

If we disregard commercial music boards, which are for the most part directed towards entertainment, the hardware approach remains the only viable one for microcomputer users who are artists as well. The types of peripherals that can be constructed fall into a few general (and arbitrary) categories:

- Organs. Integrated circuits which divide a master clock frequency into the 12 traditional tones of the octave are probably best classified this way. They are capable of creating a single waveshape that can be filtered to give the illusion of instruments or organ stops.
- Digital synthesizers. These devices are also based on a master clock, but can be divided by any computer-assigned integers to produce a tone. Certain other parameters, including volume and note duration, can be also programmed. Digital synthesizers offer greater flexibility than the organs, but are limited in timbre to square waves and demand fairly large amounts of information in order to set up their internal parameters.
- Analog synthesizers. The new generation of analog integrated circuits can be interfaced with computers to offer the speed and control of microprocessors while maintaining a familiar hands-on approach for musicians. Computers can act as intelligent "super sequencers," while the composer/performer can respond to both artistic demands and whimsy while composing or performing.
- Interfaces. Though not really a separate category, interfaces do offer an opportunity to use the existing, sophisticated musical hardware with similar existing, capable small computers. The continuing predominance of voltage-controlled synthesizers makes this especially valuable.

This article describes the construction of a simple interface for voltage-controlled synthesizers with the ability to activate up to 32 discrete voices (channels) with simple hardware and software. Although this interface


Radio Shack's $399*
TRS-80™ Color Computer--
Innovation at it's
Very Best!
The Family Christmas Gift That's Functional, Fun and Educational! Tremendous versatility and value at a breakthrough price. Something for everyone in your home! The TRS-80 Color Computer can be used with our plug-in ROM Paks, or write your own programs in BASIC. Mom and Dad can use it for any number of applications, such as keeping track of personal finances; youngsters can learn the basics of computer programming—the whole family will enjoy playing exciting color action games. It's expandable,so its capability grows with yours. Attaches to any color TV quickly and easily or get our optional TRS-80 Color Video Receiver (works as an extra TV too!).
Put a computer in your life this Christmas. Get the full story and specs from your nearest Radio Shack store, dealer or Computer Center. Over 6,000 locations, nationwide. Or write for a free TRS-80 catalog: Radio Shack, Dept. 81-A-65, 1300 One Tandy Center, Fort Worth, TX 76102.
*Retail prices may vary at individual stores and dealers.
Radio Shack
The biggest name in little computers™

is designed to work specifically with the TRS-80, signals from any eight-bit microcomputer data bus will successfully activate the device.

The reasons for choosing the voltage-controlled approach as opposed to the other options are simple. First, more commercial synthesizers of this type have been manufactured than any other. Second, one of the immediate concerns of both composers and performers is real-time, interactive *sensitivity. Controlling* the pitch, volume and tempo of the current crop of programmable sound generators (such as the Texas Instruments SN76489A or the General Instrument AY-3-8910) during performance is unwieldy, and sometimes impossible due to the internal clock speed limitations.

With technological improvements, these limitations will likely disappear. But, as a composer, I have needed a versatile and functioning system for some time. It has been 12 years since I composed my first fully electronic score, and three years later the equipment became available to create it on tape. It was written to be heard "live," with performer interaction, but 16 voices of electronic sound made that technically (or economically, at least) impossible until the time of microcomputer control and analog interfaces such as this one. Despite their tuning limitations, analog synthesizers with computer-controlled interfacing are my present choice for complex music.

### The Circuit

The master voice selection is done by four integrated circuits. (See Fig. 1.) Z1, an 81LS95 (or equivalent eight-line buffer), protects the computer's data lines from overexertion, since in a fully expanded system this data will be sent to 16 other circuits. Z2 (74LS154) accepts address lines 2, 3, 4 and 5, decoding them into 16 separate select lines. Address lines 0 and 1 are each also buffered through a pair of 74LS04 inverters (Z4). A6, A7 and the OUT signal are evaluated through a group of NAND gates (Z3), and a select signal is sent to the 74LS154. The resulting signals from these four circuits are fed to an INS 8255 programmable peripheral interface chip (Z5).

The 8255 circuit needs very little information to operate. It internally decodes address and data information, and routes data through its three separate eight-bit ports. For the synthesizer interface, port chips A and B will be used for pitch control, and port C will be used to control the envelope trigger (the signal that indicates the start of a note). The data lines are run to all of the 8255s from the output of Z1; Z2 selects one of these interface devices to receive the data. Address lines 0 and 1 are then used by the 8255 to determine where it will send the data it has received (see Table 1).

Ports A and B leading from each 8255 are connected to Motorola digital-to-analog converters, type MC1408L8 (Z6 and Z7). These circuits accept the eight-bit digital information and convert it to a current directly proportional to the numerical value of the data. The current is then transformed to a proportional voltage by Z10, an inexpensive LM324 operational amplifier. That output can be sent directly to any voltage-controlled synthesizer, where it can control pitch, volume, waveshape or any other parameters that respond to an analog voltage.

Port C is used for the envelope trigger and spare signal lines. Since some synthesizers trigger on a low voltage and others on a high voltage, this circuit is designed to

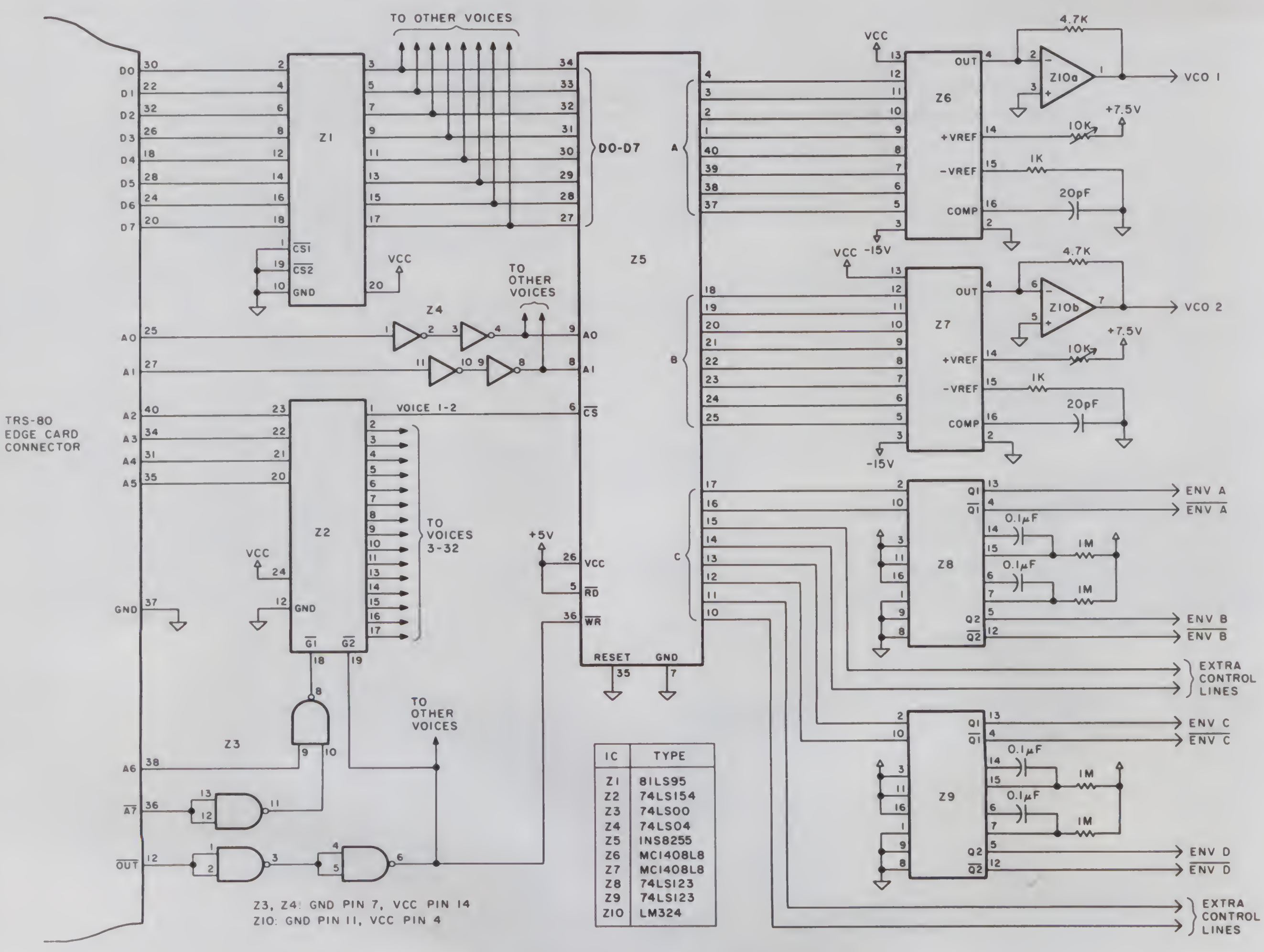



*Fig. 1. TRS-80 to voltage-controlled synthesizer interface.*

provide both.

Also, most synthesizers are quite slow in accepting envelope triggers (it is usually done from a keyboard), so that 74LS123 (Z8 and Z9) circuits lengthen the output pulse. Port C of the 8255 was chosen for this purpose because a single eight-bit instruction can individually set or reset the signals of this port, allowing much faster response to the important envelope trigger. The extra control lines can be used to provide sophisticated envelope modulation.

As shown in Fig. 1, the circuit can be directly interfaced to the TRS-80 40-pin bus, and up to four channels can be programmed in BASIC without noticeable note-to-note hesitation. The voices are mapped to ports 64 through 127, as shown in Table 2. Other processors that do not have the distinct port capability can use full 16-bit memory mapping, separately decoding the high-order (page) byte. The decoded page information can then be logically combined with the low-order decoding to select Z2. A simple WR (write) signal can be substituted for the Z-80's OUT line, as both types of signal are active low. Fig. 2 presents the very simple decoding to use page FF.

**Construction**

Layout and lead dress are not significant to the operation of the interface, but a good, well-regulated power supply is always a must for music work. The MC1408L8 D/A converters are accurate to .19 percent (just adequate for music) and are quite linear from step to step. Photo 1 shows an oscilloscope trace of the D/A converter being incremented at two-microsecond intervals. The very clean drop at the change from data 255 to data 0 demonstrates a settling time more than adequate for even the most complicated musical events.

*Photo 1. Scope trace of digital-to-analog converter output shows very linear conversion. A machine-language loop incrementing the output to the DAC from 00 to FF was used.*

R1 determines the reference voltage for Z6 and Z7, so once the circuit is designed, built and operating, it should be adjusted to calibrate each channel for identical output. In any case, a simple tuning program should be created so that either the D/A converters or the synthesizer's voltage input can be adjusted to avoid embarrassment during a performance.

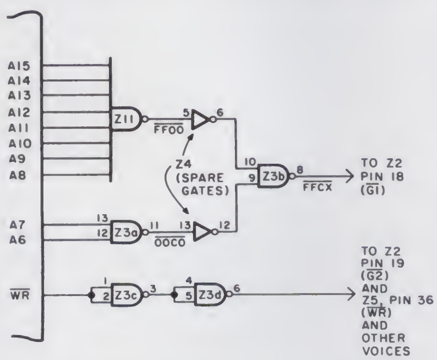



*Fig. 2. Addressing scheme for computers other than TRS-80. Interface is mapped to $FFC0 to $FFFF. Z11 is a 74LS30.*

The circuit needs three voltages. The standard regulated +5 V is for the logic circuitry, and should be about 500 mA for every two voices added. +7 to +7.5 V at a few mA is needed as a reference for the D/A converters; the exact value of this voltage is not critical, but it should be very stable for consistent pitch resolution.

Finally, a low-current −15 V source is required as a negative reference for the converter; the voltage should be precise and well-regulated. The standard LM340 or 78XX regulators can be used for an adequate supply for the interface, but remember that the current of a +5 V supply will need to be raised as the board is filled with additional voices.

Most integrated circuits for this project are commonly available from such sources as Digi-Key and Jameco. The Motorola

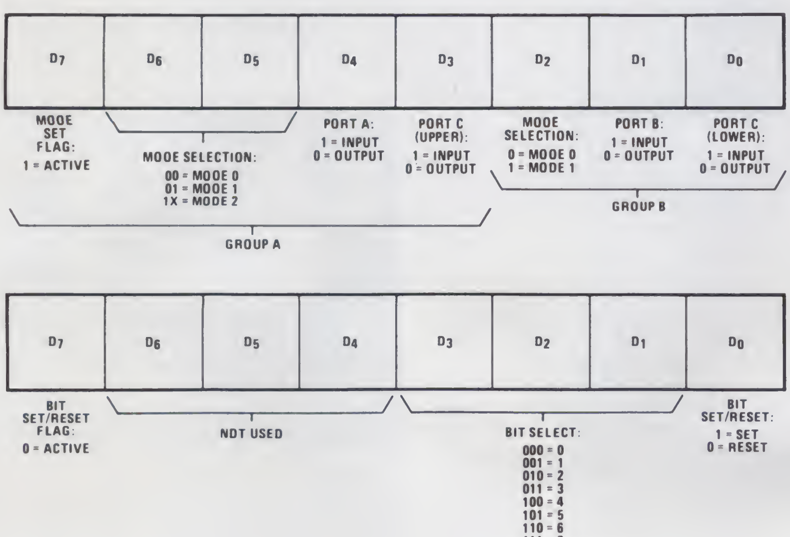
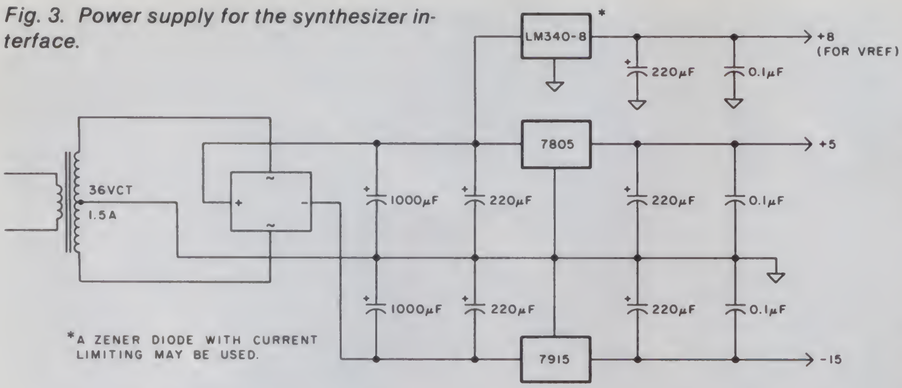



*Table 1. Mode definition control word format (top) and bit set/reset control word format (port C only). (Courtesy of National Semiconductor).*

| Port Number | Function |
|---|---|
| 64 | PITCH CONTROL VOICE 1 |
| 65 | PITCH CONTROL VOICE 2 |
| 66 | ENVELOPES 1 A/B AND 2 A/B |
| 67 | PORT CONTROL FIRST BLOCK |
| 68 | PITCH CONTROL VOICE 3 |
| 69 | PITCH CONTROL VOICE 4 |
| 70 | ENVELOPES 3 A/B AND 4 A/B |
| 71 | PORT CONTROL SECOND BLOCK |
| 72 | PITCH CONTROL VOICE 5 |
| 73 | PITCH CONTROL VOICE 6 |
| 74 | ENVELOPES 5 A/B AND 6 A/B |
| 75 | PORT CONTROL THIRD BLOCK |
| . | . |
| . | . |
| . | . |
| 124 | PITCH CONTROL VOICE 31 |
| 125 | PITCH CONTROL VOICE 32 |
| 126 | ENVELOPES 31 A/B AND 32 A/B |
| 127 | PORT CONTROL SIXTEENTH BLOCK |

*Table 2.*

*Fig. 3. Power supply for the synthesizer interface.*




*Listing 1.*

```
0 CLS
1 PRINTCHR$(23)" A GENERALIZED MUSIC PROGRAM":PRINT:PRI
    NT:PRINT
2 PRINT"DENNIS BATHORY KITSZ 5 iii 79" : FORX=1TO1500:N
    EXT:CLS
3 PRINT"THERE ARE 639 NOTES IN THE BACH PRELUDE." : Q=6
    39
4 OUT67,128 : GOTO1000 : REM * THIS IS THE TUNING ROUTI
    NE
5 DIMML(2,Q+50) : REM * THIS IS THE MUSIC LENGTH (ML)
6 PRINT:PRINT"READING";Q;"NOTES FROM MUSIC PITCH/RHYTHM
     DATA."
10 FORPH=1TOQ
20 FORNT=1TO2
30 READML(NT,PH)
40 NEXTNT,PH
45 INPUT"PRESS ENTER TO START PIECE";Z
50 FORPH=1TOQ
60 OUT66,32:OUT66,0:OUT64,ML(1,PH)
70 FORX=1TOML(2,PH):NEXT
80 NEXTPH
98 FORN=1TO2000:NEXT:OUT64,255:GOTO45
100 DATA69,31,90,31,117,31,90,31,66,31,90,31,111,31,90,
     31,69,31,90,31,117,31,90,31,54,31,102,31,126,31,10
     2,31,60,31,81,31,105,31,81,31,54,31,81,31,102,31,8
     1,31,60,31,81,31,105,31,81,31,45,31,90,31,117,31,9
     0,31
110 DATA48,31,69,31,96,31,69,31,45,31,69,31,90,31,69,31
     ,48,31,69,31,96,31,69,31,33,31,81,31,105,31,81,31,
     39,31,81,31,84,31,81,31,33,31,81,31,96,31,81,31,30
     ,31,75,31,90,31,75,31,18,31,66,31,84,31,66,31
120 DATA69,31,81,31,90,31,81,31,54,31,69,31,81,31,69,31
     ,45,31,54,31,69,31,54,31,33,31,45,31,54,31,45,31,2
     4,31,45,31,51,31,57,31,60,31,66,31,69,31,75,31,69,
     31,60,31,66,31,69,31,75,31,81,31,87,31,90,31
130 DATA75,31,87,31,96,31,87,31,60,31,75,31,87,31,75,31
     ,51,31,60,31,75,31,60,31,39,31,51,31,60,31,51,31,3
     0,31,51,31,54,31,60,31,66,31,72,31,75,31,81,31,75,
     31,66,31,72,31,75,31,81,31,87,31,90,31,96,31
140 DATA81,31,90,31,102,31,90,31,66,31,81,31,90,31,81,3
     1,54,31,66,31,81,31,66,31,45,31,54,31,66,31,54,31,
     33,31,54,31,81,31,54,31,24,31,54,31,69,31,54,31,30
     ,31,54,31,75,31,54,31,18,31,54,31,84,31,54,31
150 DATA33,31,54,31,81,31,54,31,24,31,54,31,69,31,54,31
     ,30,31,54,31,75,31,54,31,18,31,54,31,84,31,54,31,3
     3,31,54,31,81,31,54,31,36,31,60,31,90,31,60,31,39,
     31,60,31,87,31,60,31,42,31,66,31,96,31,66,31
160 DATA45,31,66,31,90,31,66,31,9,31,69,31,102,31,69,31
     ,15,31,69,31,96,31,69,31,51,31,75,31,105,31,75,31,
     54,31,75,31,102,31,75,31,18,31,81,31,111,31,81,31,
     24,31,81,31,105,31,81,31,60,31,87,31,117,31,87,31
170 DATA66,31,75,31,81,31,87,31,90,31,96,31,102,31,105,
     31,111,31,105,31,102,31,96,31,90,31,84,31,81,31,75
```

MC1408L8 can be purchased from Advanced Computer Products, PO Box 17329, Irvine, CA 92713, for about $6. A two-voice board, including hardware, will cost under $35, and each additional pair of voices will increase that cost by about $20.

### Operation

Attach the interface to the TRS-80 edge card, connect the first output of Z10 to any voltage-controlled synthesizer input and apply power to each device—the TRS-80 should be turned on last. (If you do not have a synthesizer, see "A Simple Voltage-Controlled Synthesizer" on page 66). Remove any patch to the synthesizer's envelope for this test. From the command level, enter OUT 67,128, which sets up the first 8255 interface circuit to output data to the converters. Now run the following program:

```
10 INPUT "TIME DELAY";N
20 FOR X = 0 TO 255
30 OUT 64,X
40 FOR Y = 1 TO N : NEXT Y
50 NEXT X
60 GOTO 20
```

Answer 1 to the input question in line 10, and the synthesizer should emit a series of fast-rising whoops. Each time you run the program, increase the value in response to N, and the whoops will slow until you can hear a series of discrete pitches. If everything is well, you should try the same sequence for voice 2, using OUT 71,128 to set the port and OUT 68,X for the data. Continue with each succeeding voice (see Table 2).

Now patch the envelope back in place and run Z8, pin 13, to the envelope trigger. Run the following:

```
10 A$ = INKEY$ : IF A$ = " " THEN 10
20 OUT 66,1 : OUT 66,0 : GOTO 10
```

The envelope should be triggered each time you touch a key on the TRS-80. If it is not, then run Z8, pin 4, to the trigger instead, and change line 20 to:

```
20 OUT 66,2 : OUT 66,0 : GOTO 10
```

If the envelope still is not working, in-

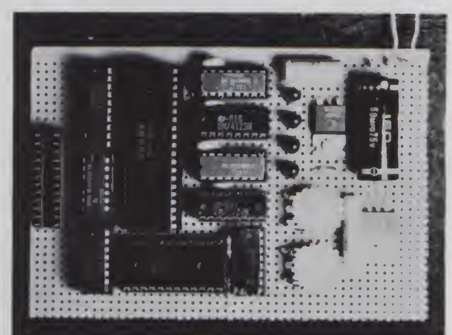


*Photo 2. The completed prototype before mounting input and output jacks and computer cable. The address decoding and peripheral interface are to the left; four LEDs to the right give a visual indication of the envelope triggers.*

*Reader Service—see page 257*

```
    ,31,81,31,69,31,66,31,60,31,54,31,48,31,45,31,39,3
    1,33,31,39,31,45,31,39,31,33,31,30,31,24,31,18,31
180 DATA15,31,75,31,105,31,75,31,18,31,75,31,102,31,75,
    31,9,31,69,31,102,31,69,31,15,31,69,31,96,31,69,31
    ,18,31,66,31,96,31,66,31,30,31,66,31,90,31,66,31,3
    3,31,60,31,90,31,60,31,39,31,60,31,87,31,60,31
190 DATA18,31,75,31,90,31,75,31,66,31,90,31,75,31,66,31
    ,54,31,66,31,75,31,66,31,54,31,75,31,66,31,54,31,3
    9,31,54,31,51,31,45,31,39,31,33,31,30,31,24,31,18,
    31,30,31,39,31,54,35,66,39,75,42,84,45,93,48
200 DATA9,250,45,15,54,15,69,15,81,15,99,15,105,15,117,
    15,126,200,45,15,54,15,69,15,81,15,99,15,105,15,11
    7,15,126,50,36,15,45,15,60,15,96,15,108,15,117,15,
    126,131,132,31,135,31,132,31,126,31,120,31,117,31,
    120,31
210 DATA126,31,123,31,117,31,111,31,108,31,111,31,117,3
    1,111,31,108,31,102,31,96,31,102,31,108,31,102,31,
    96,31,90,31,84,31,81,31,75,31,69,31,63,31,60,31,54
    ,31,48,31,45,31,39,31,36,31,30,34,24,37,18,40,12,4
    4,9,48,3,250
220 DATA39,15,48,15,60,15,75,15,96,15,111,15,120,200,39
    ,15,48,15,60,15,75,15,96,15,105,15,111,15,120,50,5
    4,15,66,15,75,15,90,15,102,15,111,15,120,131,54,31
    ,39,31,45,31,48,31,54,31,60,31,66,31,69,31
230 DATA66,31,60,31,54,31,60,31,66,31,69,31,75,31,81,31
    ,75,31,69,31,66,31,69,31,75,31,81,31,84,31,90,31,8
    4,31,81,31,75,31,81,31,84,31,90,31,96,31,102,31,10
    5,31,111,31,117,31,120,34,126,37,132,40,138,44,126
    ,48
240 DATA141,250,33,15,45,15,54,15,69,15,90,15,102,15,10
    5,15,117,200,33,15,45,15,54,15,69,15,90,15,102,15,
    105,15,117,50,48,15,60,15,69,15,84,15,96,15,105,15
    ,117,250,51,15,60,15,69,15,96,15,105,15,114,200,51
    ,15,60,15,75,15,96,15,105,15,111,50
250 DATA54,15,66,15,75,15,84,15,90,15,102,15,111,250,10
    2,15,111,31,102,31,90,31,84,31,90,31,102,31,111,31
    ,102,31,111,31,102,31,90,31,84,31,90,31,102,31,111
    ,31,129,31,126,31,120,31,114,31,111,31,105,31,102,
    31,96,31
260 DATA102,31,90,31,102,31,111,31,120,31,129,31,138,31
    ,147,31,141,93,111,31,114,31,102,31,105,31,87,31,1
    8,15,39,15,48,15,54,15,75,15,90,15,105,15,111,125,
    81,125,18,15,39,15,48,15,54,15,84,15,90,15,102,115
    ,111,031,54,125,60,125
270 DATA33,15,45,15,54,15,63,15,81,15,90,15,105,250,81,
    31,90,31,81,31,69,31,66,31,69,31,81,31,90,31,81,31
    ,90,31,81,31,69,31,66,31,69,31,81,31,90,31,108,31,
    99,31,90,31,81,31,72,31,66,31,54,31,81,31
280 DATA60,15,84,15,81,15,84,15,81,15,84,125,81,31,75,3
    1,81,31,84,31,81,31,75,31,69,31,66,31,69,31,75,31,
    69,31,66,31,60,31,54,31,60,31,66,31,60,31,54,31,48
    ,31,45,31,48,31,54,31,48,31,45,31,39,31,33,31,30,3
    1
290 DATA33,31,45,31,54,31,45,31,45,31,54,31,69,31,54,31
    ,54,31,69,31,81,31,69,31,69,31,81,31,90,31,81,31,8
    1,31,90,31,105,31,90,31,90,31,105,31,117,33,105,35
    ,105,37,117,39,126,42,117,45,141,150


1000 REM     ********TUNING SECTION**********
1005 PRINT"THIS IS THE TUNING SECTION -- OUTPUT IS 3, 3
     9, 75."
1006 PRINT"HOLD SPACE BAR TO BEGIN MUSIC DATA READING."
1008 PRINT"DISABLE ENVELOPE PATCH WHILE USING THIS SECT
     ION."
1010 OUT64,3:FORX=1TO500:NEXT
1020 OUT64,39:FORX=1TO500:NEXT
1030 OUT64,75:FORX=1TO500:NEXT
1032 OUT64,111:FORX=1TO500:NEXT
1035 OUT64,147:FORX=1TO500:NEXT
1040 A$=INKEY$ : IF A$ = "" THEN 1010 ELSE OUT68,255:GO
     TO5
```

crease the values for C3 or R5, which are found at pins 14 and 15 of Z8. This will lengthen the trigger cycle to accommodate any synthesizer. Again, try both the above connections.

When everything is working well, give the sample program in Listing 1 a try. It is Bach's 21st Prelude, and, even though it is a single-voice piece (mostly), it is still a treat to hear. A tuning section is included to match my arbitrary selection of values for pitches.

This program is for example only; ideally, a music compiler should be written to accommodate a composer's (or a composition's) individual requirements. Micro- and macrotonal scales might be used merely by retuning the reference voltage on either the synthesizer or this interface. Likewise, straightforward tonal music using standard rhythms would require only a simple input program, perhaps with notations such as "A#4H" or "Bb2Q" to distinguish pitches, octaves and rhythms. Even key signatures could be entered once, as in traditional scores.

Overall, the voltage-controlled interface will provide an effective, albeit interim, solution to composers and electronic music hobbyists who want to perform or create either simple or complex music easily and inexpensively. ■

# WE WILL NOT BE UNDERSOLD

## DISK DRIVES $314

40 track, 102K Bytes. Includes power supply and TRS-80* compatible silver enclosure. Ready to plug-in and run the moment you receive it. Can be intermixed with each other and Radio Shack drive on same cable. 90 day warranty. One year on power supply. Available for 220 Vac (50 Hz) operation. **External card edge included.**

| | | |
|---|---|---|
| **FOR TRS-80*** | | |
| CCI-100 | 5¼", 40 Track (102K Bytes) for Model I | **$314** |
| CCI-280 | 5¼", 80 Track (204K Bytes) for Model I | **$449** |
| CCI-800 | 8" Drive for Model II (½ Meg Bytes) | **$795** |
| **For Zenith Z89** | | |
| CCI-189 | 5¼", 40 Track (102K Bytes) add-on drive | **$394** |
| Z-87 | Dual 5¼" add-on drive system | **$995** |

**DISKETTES** — Box of 10 (5¼") - with plastic library case
**Maxell** **$30** **BASF or Verbatim** **$24**
8" double density for Model II (box of 10) **$36**
**CLEAR PLASTIC CASE** - Holds 50 diskettes **$19**

## DISK OPERATING SYSTEMS

**PATCHPAK #4 by Percom Data** **$ 8.95**
**CP/M**® for Model I, Zenith **$145** • for Model II, Altos **$169.00**
**NEWDOS Plus** **40track** **$ 95.00**
***NEWDOS 80*** **$135.00**

## COMPLETE SYSTEMS

**ALTOS 64K, DD, SS, 2-Drive, 1MB** **ACS 8000-2** **$3395**
**APPLE 16K** **$988**
**TRS-80* Model II-64K** **$3499**
**TRS-80* LEVEL II-16K with keypad** **$689**
**TRS-80* Expansion Interface** **$249**
**HEWLETT PACKARD HP-85** **$2790**
**ZENITH Z89, 48K** all-in-one computer **$2440**
**ZENITH Z19** **$735**
**TELEVIDEO** **912B $698** **912C $698** **920B $748** **920C $748**
**ATARI 400 $489** **ATARI 800 $747**
**APF** **Game Only $99** **Complete System $499**
**MATTEL INTELLIVISION** **$229**

## MONITORS

| | | |
|---|---|---|
| **LEEDEX** | 12" B & W Video 100 | **$129** |
| **ZENITH** | 13" Color | **$379** |
| **SANYO** | 9" B & W VM4509 | **$155** |
| **SANYO** | 12" B & W DM5012 | **$210** |
| **SANYO** | 12" Green Screen DM5112 | **$215** |
| **SANYO** | 13" Color DMC6013 | **$375** |
| **APF** | 9" B & W TVM-10 | **$139** |

## TELECOMMUNICATIONS

**CAT MODEM** Works same as Radio Shack Telephone Interface II **$148**
**D-CAT HARD WIRED DIRECT MODEM** **$199**

## COMMUNICATIONS SOFTWARE

**CCI-TELNET VERSION 5:** A communication package which enables microcomputer users to communicate both with large mainframes and other microcomputers. Completely CP/M compatible. Multiple communication protocols supported. **$149**

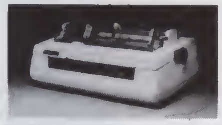
**INTELLIGENT TERMINAL SYSTEM ST-80 III:** Enables a TRS-80* to act as a dial-up terminal on any time sharing network. **$139**

## 16K MEMORY UPGRADE KITS 2 for $82.50 $43

200 ns for TRS-80*, Apple II, (specify): **Jumpers** **$2.50**

## PRINTERS

### NEC Spinwriter



**Letter Quality High Speed Printer**
Includes TRS-80* interface software, quick change print fonts, 55 cps, bidirectional, high resolution plotting, graphing, proportional spacing: R.O. **$2395**
R.O. with Tractor Feed **$2575** KSR with Tractor Feed **$2950**

**C.ITOH Starwriter,** 25 CPS, daisy wheel printer **$1895**
**C.ITOH Starwriter II,** 45 CPS, daisy wheel printer **$2195**
Letter quality printers. Use up to 15" paper. 1 year warranty on parts. 3 months on labor. Proportional spacing and bidirectional printing. Same as VISTA V300.

**779 CENTRONICS TRACTOR FEED PRINTER** **$969**
Same as Radio Shack line printer I
**737 CENTRONICS FRICTION & PIN FEED PRINTER** **$795**
n × 9 proportional and 7 × 8 mono spacing.
Same as Radio Shack line printer IV
**730 CENTRONICS FRICTION & PIN FEED PRINTER** **$595**
7 × 7 matrix Same as Radio Shack line printer II
**P1 CENTRONICS PRINTER** Same as Radio Shack quick printer **$269**
**PAPER TIGER** (IP440) Includes 2K buffer and graphics option **$879**
(IP460) Bidirectional, 160 cps, graphics and 2K buffer **$1075**
**TI-810** Faster than Radio Shack line printer III. Parallel and serial w/TRS-80* interface software w/u + I case & paper tray **$1589**
Compressed print, vertical form control **$1865**
**OKIDATA Microline 80** Friction and pin feed **$545**
Tractor Feed, friction, and pin feed **$645**
**Microline 83** Bidirectional, 120 cps, uses up to 15" paper **$1050**
**EATON LRC 7000 +** 64 columns, plain paper **$289**
**ANADEX** **DP-9500/01** **$1350** **DP-8000** **$795**

## ACCESSORIES

**HEAD CLEANING DISKETTE:** Cleans drive Read/Write head in 30 seconds. Specify 5¼" or 8". **$20 ea/$45 for 3**

**FLOPPY SAVER:** Protection for center holes of 5¼" floppy disks. Installation tools and rings for 25 diskettes. **$ 11.95**
**Re-orders of rings only** **$ 6.95**

**EXTERNAL DATA SEPARATOR:** Eliminates data separation problems (crc). Improves reliability. This plug in unit comes fully assembled and tested. **$ 29.95**

**Z-80 SOFTCARD:** Your key to software expansion. The plug-in Z-80 Softcard transforms your Apple into a Z-80 while keeping all the benefits of the 6502. Comes with CP/M in two disk format, MBASIC and GBASIC, full documentation and utility programs. **$339**

**RF MODULATOR:** Adapts video to TV **$ 35.00**
**TRS-80 & OTHER MYSTERIES** **$ 18.95**
**NEC SPINWRITER THIMBLE** **$11.95** **RIBBON** **$ 6.00**
**CCS CARDS:** Parallel or serial printer interface cards **$115.00**
**RS232:** For Radio Shack Interface. **$ 84.00**
**TRS232:** Teletype current loop output from cassette port **$ 49.00**
**DISK-DRIVE EXTENDER CABLES:** Fits all mini-disk drives. **$ 16.95**
**SIX (6) PRONG ISOLATOR:** ISO-2 **$ 54.00**
**AC FILTER/6 PRONG POWER STRIP** **$ 39.00**
**DISK DRIVE CABLES:** 2 drive **$29.00** 4 drive **$ 35.00**
**DUST COVERS:** TRS-80/Apple **$ 7.95**
**PLASTIC DISKETTE HOLDER:** For ring binder, holds 20 **$ 8.00**

For fast delivery, send certified checks, money orders or direct bank wire transfers. Personal or company checks require two to three weeks to clear.

**DEALER (NATIONAL/INTERNATIONAL) INQUIRIES INVITED** **Send for FREE Catalogue**

# The CPU SHOP ✓256

**TO ORDER CALL TOLL FREE 1-800-343-6522**
**TWX: 710-348-1796** Massachusetts Residents call 617/242-3361

5 Dexter Row, Dept. K12M
Charlestown, Massachusetts 02129
Hours 10AM-6PM (EST) Mon.-Fri. (Sat. till 5)

Massachusetts Residents add 5% Sales Tax
*TRS-80 is a Tandy Corporation Trademark
® Digital Research

## LOW COST IMPACT PRINTER

**48 Column Impact Printer** available in KIT form or ASSEMBLED and TESTED, ready to be connected to your computer. Primary features include: Microprocessor controlled and programmable with 32 system level software commands, 96 ASCII characters with upper and lower case, no eye straining print with 9 software selectable sizes from 5 x 7 to larger 10 x 7 and 10 x 14 character fonts, reverse font printing capability, standard parallel and serial interface, baudrate selectable from 110 to 9600 baud, plus many more functions at your command.

Prices for KITS are $295 (101A-48K) without enclosure and $325 (101A-48KE) with enclosure. KITS include all electronics, mechanical parts and detailed assembly instructions.

ASSEMBLED and TESTED Impact Printers—prices are: $325 (101A-48) excluding enclosure, $355 (101A-48E) with enclosure.

For further information, contact:

**COOSOL, INC.** ✓292
P.O. Box 743, Anaheim, Ca. 92805 Phone: (714) 545-2216
(7 days a week)

## Educational Software Professionals, Ltd.

APPLE

**HI-RES TITRATION**

HI-RES TITRATION is a simulation of an acid base titration using the Apple high-resolution color graphics. The program was written for use as a prelaboratory preparation and practice. It is effective as a lecture demonstration or for use by individual students. The program was written for high school use, but it is also useful for college chemistry classes.

32K Applesoft with Disk .............................. $19.95

**RETAILING MATH**

RETAILING MATH is a computer assisted instruction in the fundamentals of pricing mathematics. Lessons and reviews dealing with the mark-up equation, mark-up percentage and determining retail and cost prices are reinforced thru interactive exercises after each lesson by vocationally certified instructions.

48K Applesoft with Disk .............................. $39.95

**EDUCATIONAL CHARADES**

EDUCATIONAL CHARADES is an age-long game modified for classroom use. The teacher can create charade files relative to the current subject being taught.

32K Applesoft with Disk .............................. $19.95

**APPLE-GRAMMER** requires 32K in Applesoft and a disk drive ... ............ $19.95

**TEACHERS' AIDE I** with Multi-Choice format requires 32K in Applesoft and a disk drive ............................ 19.95

**TEACHERS' AIDE II** with True and False format requires 32K in Applesoft and a disk drive ............................ $19.95

**38437 Grand River • Farmington Hills, MI 48018**
**(313) 477-4470** ✓156
*Dealer' Inquiries Welcome*

## Computer House Div.

### *Programs for Commodore Computers*

1 - F.E.T.-Recover; File Editing Tools, Adds 11 commands to assist disk recovery ..........$65.00
2 - SOF-BKUP; copy disks faster including random files. Displays error messages for bad blocks. .....$40.00
3 - SUPER-RAM; checks every ram address against every other ram address, 2001 series.........$20.00
4 - VARI-PRINT; prints listing of all variables with every line number where each occurs ........$25.00
5 - DOCU-PRINT; prints CRT to printer, use in your own program, in basic .....................$20.00
6 - SCREEN DUMP/REPEAT; similar to DOCU-PRINT except in machine language. Use with anyones program, REPEAT similar to Model 8032......$35.00
7 - TRACE-PRINT; prints listing of all line numbers in order of execution ......................$25.00
8 - SCRUNCH-PLUS; packs a copy of program to save up to 25% of memory space............$25.00
9- -SORTER; sorts a one dimensional array alphabetically (in machine language)..............$35.00

PACKAGE PRICE $170.00 FOR ALL 9 PROGRAMS
SAVE $120.00

Dealer inquiries invited ✓215

**COMPUTER HOUSE DIV.**
**1407 Clinton Road**
**Jackson, Michigan 49202**
**Phone: (517) 782-2132**

## Free Gift for Heathkit® Owners

Subscribe to Buss: The Independent Newsletter of Heath Co. Computers and receive as a special bonus a free directory of over 60 suppliers of hardware and software for Heathkit® computers products and Zenith Data Systems. Buss spreads the latest news of compatible hardware and software from many venders. The newsletter is not affiliated with any of these and does not depend on income from ads. So Buss has to please only its subscribers — over 3000 of them.

Readers' candid reports of their discoveries save other subscribers headaches — and money. Innovations published in Buss have included hardware modifications and software fixes. And, since it is not a company-controlled publication, Buss can deal with both the weaknesses and the strengths of Heath Co. computer products.

Buss is a proven newsletter that keeps getting better. It's been published since April 1977. Our supplier directory is based on over three years of coverage of Heathkit® computers. You have the choice of starting your Buss subscription with the latest issue or available back issues (about 14). All this information will be mailed first class (by air mail overseas). Full refund guaranteed if you're not satisfied. Payment must be in U.S. dollars payable on a U.S. bank or by international postal money order.

| | U.S. & Canada | Overseas |
|---|---|---|
| 12 issues | $17.99 | $25.00 |
| 18 issues | $24.87 | $30.00 |
| 24 issues | $29.98 | $35.00 |

Buss ✓326
325-K Pennsylvania Ave., S.E.
Washington, DC 20003

# Music Transcriber

*Write sheet music instantly on your TV screen as you play a tune on a piano-like keyboard.*

*Peter Bendix*
*1048 Border Road*
*Los Altos, CA 94022*

Computers are being used extensively to generate electronic music. With this music transcriber, you can compose on a piano-like keyboard and see it appear on your TV video screen as sheet music.

The system operates in real time—it can enter notes as fast as you can play them. Using a three octave keyboard, you enter up to 20 single notes on a music staff. The computer automatically determines the length of time each note is held. It also times the rests between notes.

While this transcriber has its limitations, it has a wide variety of applications. Beginning music students, for example, can play a tune on the keyboard and see the corresponding musical notation immediately. More advanced musicians can use the transcriber to improve their sight-reading abilities by playing a series of notes exactly as they appear on the screen.

Professional musicians can also use the transcriber to compose. Many performers have a difficult time putting a tune down on paper. The transcriber can help them with the basic skills of written transcription. The skilled musician will not find it difficult to go beyond the computer and polish a score into a more standard form.

### Hardware

The music transcriber is built around a "cheap video system" (see Don Lancaster's *The Cheap Video Cookbook).* The component parts of the transcriber are a KIM-1 microcomputer, a TVT 6-5/8 video board, a home-brew 4K memory board (wire-wrapped and built to plug onto the KIM-1 expansion connector), a PAIA 37-note encoded keyboard, model no. 8782, a Radio Shack cassette recorder (for storing programs), a dual voltage power supply (5 volts at 2 amps, 12 volts at 1/2 amp) and a TV monitor or converted TV.

The KIM-1 and TVT 6-5/8 will give you the least expensive and most flexible graphics system. It may be possible to apply the techniques (and software) of this article to an Apple, but any other microcomputer will require much more effort. In particular, you need a system capable of controlling graphics dot by dot, not character by character, which eliminates the TRS-80 and PET.

You can use any keyboard, but PAIA has many to choose from, and they supply lots of extra boards you may want to incorporate.

The PAIA keyboard encoder circuit is CMOS and is supplied with a 9-volt power supply. I had trouble getting it to work properly at 9 volts (the oscillator on the key scanning board wouldn't oscillate), but running it at 5 volts overcomes the difficulty. This 5-volt modification is also convenient for interfacing the encoder logic to the KIM-1 (KIM ports are TTL).

You'll want to hear the notes of the keys as you play them, so you'll need a tone generator. PAIA has one (model no. EK-6) but I built my own, mainly because for polyphonic music you have to modify the tone generator board anyway.

Rod Hallen's article "PAIA 8700 Revisited" *(Microcomputing,* October 1979, p. 40)

| | Key Hit | Hex Data |
|---|---|---|
| | Low C | 90 |
| | C # | 91 |
| Low Octave | D | 92 |
| | • | • |
| | • | • |
| | • | • |
| | Mid C | 9C |
| | C # | 9D |
| Mid Octave | D | 9E |
| | • | • |
| | • | • |
| | • | • |
| | High C | A8 |
| | C # | A9 |
| High Octave | D | AA |
| | • | • |
| | • | • |
| | • | • |
| | C | B4 |

*Table 1. Hex data appearing at KIM port corresponding to key hit.*

*Photo 1. Overall view of KIM-1, TVT 6-5/8, 4K memory board, PAIA keyboard and tone and encoder boards, TV monitor, cassette recorder and dual voltage power supply.*

describes a tone generator circuit similar to mine. The circuit I use consists of a Mostek 50240 12-tone generator chip and support circuitry to get three octaves worth of tones. A CMOS oscillator runs the 50240 directly for the top octave; for the mid-octave the oscillator is divided in half; and for the low octave it is divided in half again using 4013 flip-flops. All outputs of the 50240 are fed through Tri-state buffers to a small amp and four-inch speaker built into the PAIA keyboard (not supplied by PAIA).

The PAIA encoder has six data lines D0–D5 plus a strobe (and $\overline{\text{strobe}}$). The data lines give a six-digit binary number representing the key hit on the keyboard. I connect the D0 line to port PA0 on the KIM-1 application connector, D1 to PA1, and so on, up to D5 to PA5. Then I connect $\overline{\text{strobe}}$ to PA6 and leave PA7 unconnected. (Each time a key is hit, $\overline{\text{strobe}}$ goes low.) With this arrangement the KIM-1 will read the hexadecimal numbers given in Table 1 at its port when the corresponding key is hit.

Referring to the circuit of Fig. 1, the data lines D0–D5 are first fed to some simple gate array to determine the octave of the key hit (low, mid or high). The L, M, H signals choose the appropriate oscillator division to run the 50240 and also combine with the data lines in a 4008 adder to select the right Tri-state buffer (to the speaker) via a 4515 one-of-sixteen decoder.

I find it beneficial to throw in an extra 10-volt, 1/2-amp power supply to run the speaker amp, 50240 and associated oscillator. Unfortunately, this leads to level shift juggling to match TTL signals with the higher 50240 output signals. Simple voltage divider resistor pairs are used for the level shifting. The complete circuit for the tone generator is given in Fig. 1.

The 4K memory addition shouldn't require much explanation (alternatively, you can use a ready-made board). The 4K memory resides in locations 0400 to 13FF of the KIM. Lines CS1–CS4 select each 1K block of the 4K memory (Fig. 2). Line SEO is an output line from the TVT 6-5/8 board and is used to tell if you are addressing the 4K memory normally or for raster scanning.

Mount the memory and support ICs on a 4 × 5 inch vector board and attach a double-sided 22-pin edge connector (female) with brackets to the vector board, so that the female side can plug into the KIM expansion connector. Note that you will have to remove whatever connections were previously on the expansion connector and attach them directly to the KIM board to free the expansion connector for the 4K memory plug-in.

You will use all address and data pins on the expansion connector as well as pins R/W, $\overline{\text{R/W}}$, V + and GND. The KIM + 5-volt power supply must be capable of 2 amps to run this memory board and the KIM together. Note in Fig. 2 that you can eliminate many gates and address lines by using the KIM-1 lines K1–K4 on the application connector. I abandoned this approach, although it should work.

You'll also need to modify the wiring to the KIM/TVT switch installed on the KIM-1 during TVT 6-5/8 interfacing. First remove the wire to CSO from the TVT board connector (pin 16) and remove the other end of this wire from the switch. Next reconnect the open cut on the KIM-1 (connect pin 1 of U4 to pin 13 of U5–U12 on the KIM-1). Also be sure to remove all upstream tap connections on the KIM-1 and *move them over to* the appropriate tap locations on the 4K memory board (see Fig. 2).

One more hardware addition is necessary before we can look at the software. Don Lancaster's *The Cheap Video Cookbook* includes a chapter on transparency (changing video information without losing sync). Lancaster gives a circuit and the appropriate software for a 64-microsecond line, 128 lines/frame transparent scan pro-

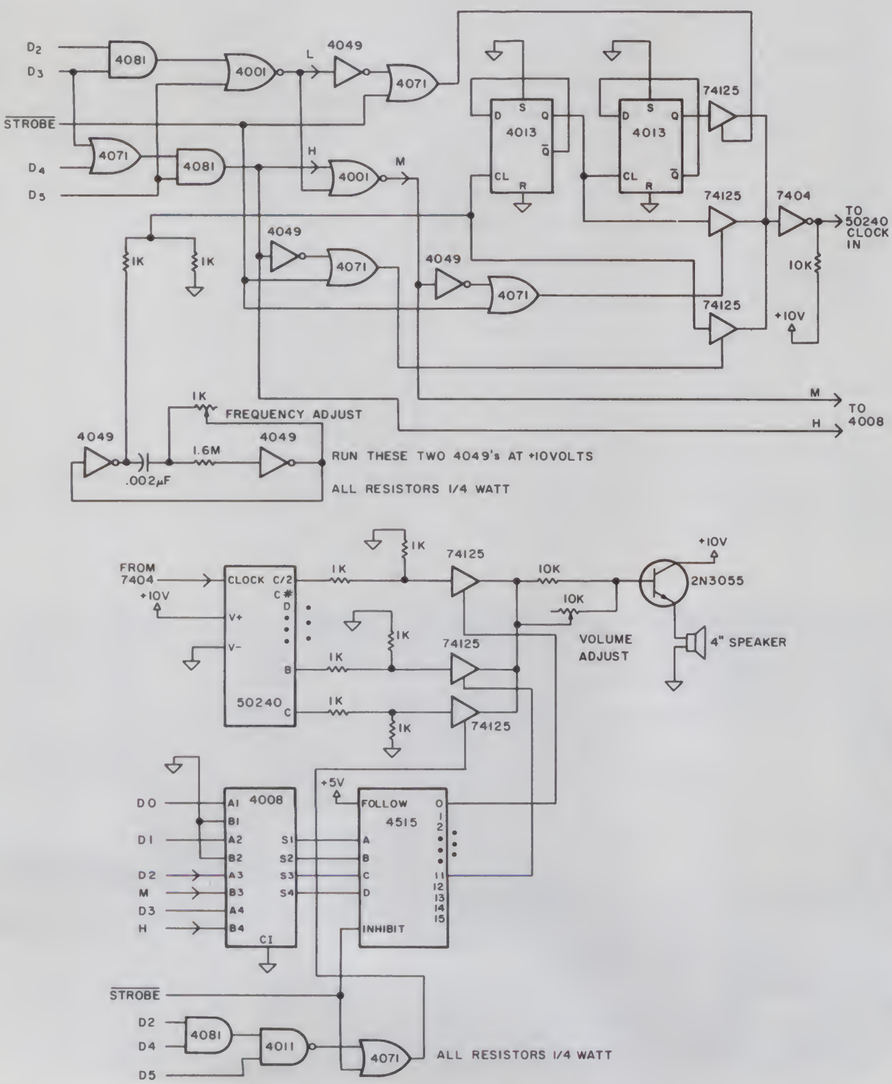



*Fig. 1. Three-octave tone generator circuit. All CMOS run at + 5 volts unless otherwise specified.*

*Photo 2. Closer view of KIM-1, TVT 6-5/8 (with added transparency board) and 4K memory board.*

gram (Figs. 5–8, pp. 216–7). I prefer to use a 63-microsecond line time and have a larger number of lines/frame. I therefore modified Don's circuit and scan program. The circuit is shown in Fig. 3; I will discuss the scan program in the section on software.

The two 4520 counters (Fig. 3) are a divide-by-7 and divide-by-9 arrangement, so that the series combination of the two gives a divide-by-63 counter. The 4040, as wired in Fig. 3, is a divide-by-128 counter. The 4528s are for waveshaping. Remember to remove HIN (TVT connector pin 3) from DEN (TVT connector pin 20) so that horizontal sync now comes from the circuit of Fig. 3.

Note that the switch in Fig. 3 coming off the last 4528 should be in the off position for normal KIM operation (especially when loading to or from tape) and is switched on when you are ready to run a scan program (generate a raster).

The circuit of Fig. 3 and its associated scan program will produce a vertical sync pulse every 16.67 milliseconds (1/60 second/frame). Roughly four milliseconds after vertical sync the IRQ line pulses low; close to eight milliseconds after this it pulses low again; about four milliseconds after this another vertical sync pulse is generated. This is a peculiar arrangement but provides a full screen of graphics (over 200 lines) and also lets you position the display vertically via software. I chose the 63-microsecond line time instead of the 64-microsecond time because most scan programs written previously in the book are set up for 63-microsec-

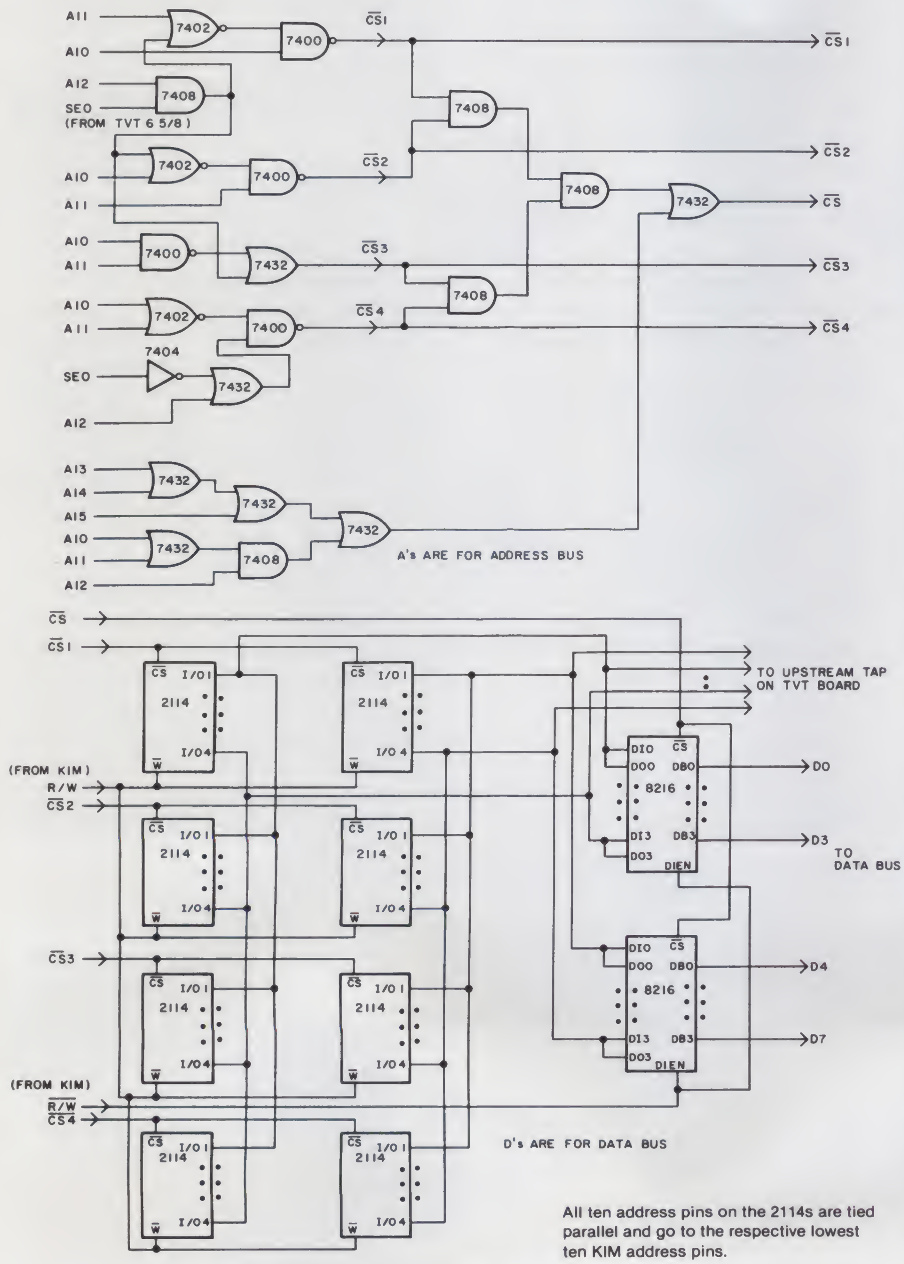



Fig. 2. *4K memory circuit for KIM-1 expansion connector.*

✓ *Reader Service—see page 257*

Photo 3. Full view of keyboard.

Photo 4. Closer view of tone generator board (foreground) and encoder board (background).

ond line times.

For those who want to stick with Lancaster's setup, there are some trivial printing errors in the scan program and some not-so-trivial subtleties associated with transparency in general. His circuit and associated scan program as printed will not work properly together.

**Software**

The software to run the music transcriber is in two main parts. The first is the scan program that puts display information onto the TV screen. This short program deals with register saves and returns associated with transparency and a normal graphics scan program. The bulk of the software is the transcriber program, which deals with reading the keys hit, timing the keys and updating display memory.

Listing 1 shows the Scan program. The part from 1780 to 17A5 is the heart of the scan program. This part should be obvious to those familiar with Lancaster; you'll otherwise find it difficult to understand the Scan program. The section from 17AA to 17C1 is the entry part of the total Scan program and is just a preliminary register save and interrupt jitter adjustment. The section from 17C2 to 17DE is the last part of the total Scan program and deals with register returns and delay before vertical sync. The delay from 17C7 to 17D4 is adjusted to give close to 1/60 of a second between vertical sync pulses.

The Transcriber program (Listing 2) is lengthy. To put sheet music on the TV screen, you first need to clear the screen and put down five staff lines and a music treble clef symbol. Eventually, you'll want more capability than this, but that is for future development.

Next, you need to read the KIM port attached to the keyboard encoder to see if a key is hit. If no key is hit you keep reading the port; if a key is hit you store the data word corresponding to the hit key in a memory byte and go on to process this information. Processing for note entry can be subdivided as follows:

1. Set timer to determine length of note.
2. Determine if key hit is a black or white key (all black keys are entered as flatted notes; no sharps).
3. If key hit is black, prepare to enter a flat symbol and then the note symbol. If white key, prepare to enter note symbol only.
4. Determine if note is in upper or lower half of staff (i.e., above or below C in the middle of the staff lines). Quarter, eighth and sixteenth notes in the upper half of the staff have bars pointing down like this ; those in the lower half of the staff have bars pointing up like this .
5. Add flags to note if necessary (i.e., eighth notes get one flag like this ; sixteenth notes get two flags like this ).
6. Determine if note is above or below the staff lines. If so, prepare to enter appropriate number of horizontal bars to the note; e.g., low C = , low A = .
7. Enter note; move right one note space on the staff. If end of staff, clear display, enter staff lines and treble clef symbol and start new note at leftmost position on staff. If more space is left on staff, time the rest between this note and the next one.
8. Enter appropriate rest symbol; move right one note space on the staff. If end of staff, clear display, enter staff lines and treble clef symbol and start new note at leftmost position on staff. If not end of staff, go back to read key port for next note.

The flowchart for this sequence is shown in Fig. 4.

The Transcriber program starts at location 0100. This is the control area from 0100 to 0144. The control area first calls subroutine Clear Display Memory and Load Staff Bars, which resides from 0030 to 007D. The control area then calls the subroutine Enter Character Cell in 0080 to 00C0 and enters the treble clef symbol. Then the control area reads the key port to see if a key is hit. If not, it keeps reading the port.

If a key is hit, the program jumps to the Time Note section from 0300 to 0327. Then it goes to the Type of Note or Rest section,

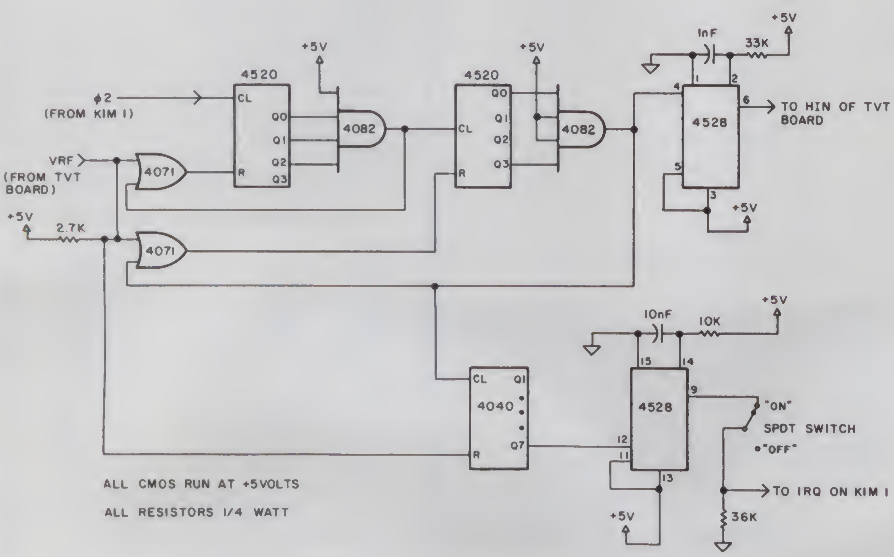



Fig. 3. Transparency addition to TVT 6-5/8 board for 63 microseconds/line.

# METAMORPHOSIS!


Now you can add high resolution graphics to your Commodore PET computer. The MTU K-1008-6 GRAPHIC INTERFACE can be used with either old, new, or business PET computers. It is simple to use, and fits inside the PET for protection.

The GRAPHIC INTERFACE gives you easy control over each dot in a matrix which is 320 wide by 200 high for a total of 64,000 dots. Because each dot can be controlled, either graphic images, text lines, or any mixture of the two can be displayed. Since each dot is controlled from software you can even design your own special character font or graphic image set (logic, chemical, architectural).

INTERFACE TO ALL PETS - With separate connector boards for each style PET (K-1007-2 for OLD PETS, K-1007-3 for NEW). The K-1008-6 can be used with either.

THREE TYPES OF VIDEO - You can select either normal PET video, graphic video, or the COMBINED image of both video signals simultaneously!

8K RAM MEMORY EXPANSION - The graphic matrix requires 8K RAM which is supplied onboard. This memory can be used for program or data storage when not being used for graphics (or see your program in binary on the display!).

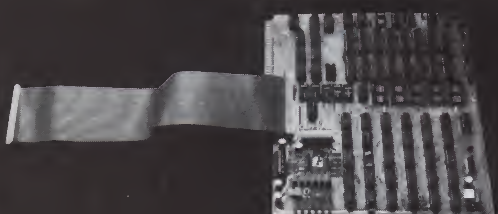
## OLD OR NEW PETS CAN NOW HAVE HIGH RESOLUTION GRAPHICS

FLEXIBLY ADDRESSED ROM SOCKETS - Five ROM sockets are included on the board. They can be set *at the same* or different addresses, with you controlling which sockets are enabled at any time through software control. You also choose the sockets to be enabled when the PET is turned on.

EXTERNAL EXPANSION - This board also creates the KIM memory expansion bus supported by all MTU products. This allows insertion into our K-1005-P card file for expansion up to 4 other boards outside the PET case.

LIGHT PEN - The board has been designed to work with an optional light pen which MTU will be announcing soon.

SOFTWARE INTERFACED TO BASIC - MTU also has available machine language software to allow you to plot points, draw lines, and display characters at high speed.



Call or write for our full line catalog of products.

MICRO TECHNOLOGY UNLIMITED
P.O. Box 12106
2806 Hillsborough Street
Raleigh, N.C. 27605
(919) 833-1458

Reader Service No. 154

MTU
Micro Technology Unlimited
P.O. Box 12106
2806 Hillsborough Street
Raleigh, N.C. 27605

which determines what type of note to enter (i.e., 1/4 note, 1/2 note, etc.) based on the results of Time Note. The Type of Note or Rest is located in 0330 to 038C.

Next comes Vertical Shift Determination, from 0390 to 108A. This section determines where vertically to place the notes on the staff. After this comes Flat Entry, which decides if a black note was hit, and if so, enters a flat symbol. This part lies in 1090 to 10CA. The program then goes to Note Entry, from 10D0 to 117C, which actually enters the appropriate note based on information from previous sections.

After Note Entry, the program goes to Bars on Notes, from 1180 to 11FF. As its name implies, this section puts the appropriate number of horizontal bars on notes below or above the staff lines (only for highest or lowest note areas). This completes the processing for note entry, so the program now goes to Time Rest from 1200 to 122E. Here it times the silent interval between notes and then goes back to Type of Note or Rest to determine what type of rest to enter (i.e., 1/4 rest, 1/2 rest, etc.).

Then the program jumps to Rest Entry from 1230 to 1290 and enters the appropriate rest symbol. It finally jumps back to the control area and gets ready to read the next note. All graphics data (treble clef, flat, notes and rests) reside in 0200 to 02E7. A small section used to set the tempo is given in 1292 to 12E3. The small subroutine from 12F0 to 1304 vertically shifts notes before they are entered (this will be used more in future development for such things as key signature changes).

The following covers each section of the transcriber program in more detail.

```
1780  LDA  A9  84          Initialize.
1782  STA  8D  90  17
1785  LDA  A9  00
1787  STA  8D  8F  17

178A  NOP  EA              Timing.
178B  LDX  A2  04          Load # of 8 line groups for display.
178D  CLC  18
178E  JSR  20  00  84      1st line.

1791  ADC  69  20          Next line.
1793  STA  8D  8F  17
1796  BCC  90  09          8 line group finished? No. Go to 17A1.
1798  INC  EE  90  17      Yes. Prepare for next 8 line group.

179B  DEX  CA              Decrement # of 8 line groups left.
179C  BNE  D0  EF          Finished? No. Go to 178D.
179E  JMP  4C  C2  17      Yes. Go to 17C2.
17A1  PHA  48              Timing.

17A2  PLA  68
17A3  JMP  4C  8D  17      Go to scan next line.
--------------------------------------------------------
 IRQ enters here
>17AA  PHA  48             Save Accumulator and X & Y registers.
17AB  TYA  98
17AC  PHA  48
17AD  TXA  8A

17AE  PHA  48
17AF  LDA  AD  46  17      Read timer.
17B2  EOR  49  FE          Adjust for interrupt jitter.
17B4  LSR  4A

17B5  BCS  B0  00
17B7  CLC  18
17B8  ROL  2A
17B9  STA  8D  BD  17
17BC  JSR  20  00  60
17BF  JMP  4C  80  17      Go to main part of scan program.
--------------------------------------------------------
17C2  LDA  A9  85          Set timer.
17C4  STA  8D  44  17
17C7  LDX  A2  09          Delay before vertical sync.
17C9  LDY  A0  DF

17CB  DEY  88
17CC  BNE  D0  FD
17CE  DEX  CA
17CF  BNE  D0  F8

17D1  LDY  A0  4B
17D3  DEY  88
17D4  BNE  D0  FD
17D6  LDA  AD  00  E0      Vertical sync pulse.

17D9  PLA  68              Return Accumulator and X & Y registers.
17DA  TAX  AA
17DB  PLA  68
17DC  TAY  A8

17DD  PLA  68
17DE  RTI  40
```

*Listing 1. Scan program for 32 lines, 63-microsecond line time. Use module B, set switches on TVT 6-5/8 to "fast," "32," "–," "off." Load 17FE = AA, 17FF = 17 for interrupt vector.*

## Control Area

The X register is a pointer for the horizontal location of the next character cell entered on the screen. The hexadecimal value

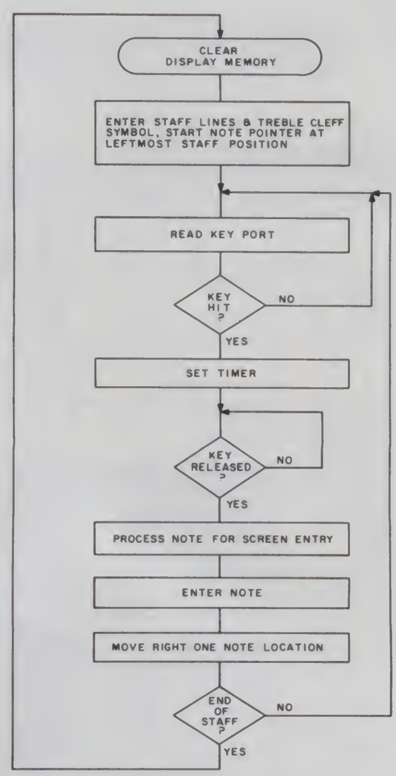



*Fig. 4. Note Entry flowchart.*

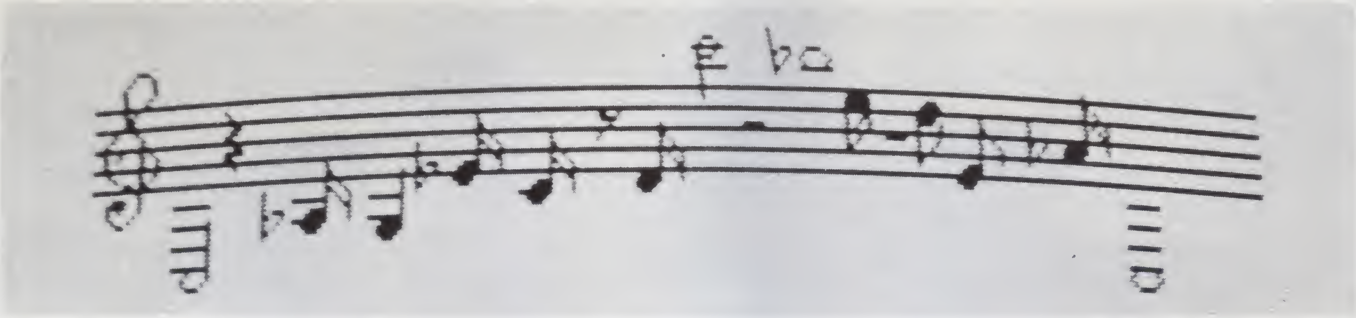


*Photo 5. Closer view of actual music on TV monitor.*

00 is the leftmost position, and the value 1F is the rightmost. The treble clef is a larger symbol than the flat, notes and rests. It is 32 lines vertically and two cells wide (16 dots wide). Therefore, to enter the treble clef symbol, you have to call the Enter Character Cell subroutine twice.

Also, after the treble clef symbol is entered, you want to enter flat and note symbols smaller than the treble clef symbol so you must change the character cell size from 32 to 14 lines (in line 0111). When a key is hit, the data goes into location 01B0.

**Load Staff Bars**

Five staff bars must be loaded, and each has a space of three lines between itself and the next staff bar. Display memory starts at location 0400, and the first staff bar begins in location 05E0. Thus, the first staff bar is the sixteenth line from the top of display memory (first line = 0400 to 041F, next line = 0420 to 043F, etc.).

**Enter Character Cell**

When entering a note or other symbol, you superimpose it over the staff lines so as not to erase part of the staff. Therefore, in line 0085, use the ORA instruction. Data is stored in memory in compressed form so it is read from memory in consecutive bytes (see line 008E). However, entering this data into display memory is not by consecutive bytes, but rather by consecutive rows (see line 0095).

**Time Note**

After the timer is read, store the time in location 03FF. Location 0306 holds the data for the basic unit of time. Whenever the time is counted down to zero (starting from the number given in 0306) add one to location 03FF. Thus, to vary the tempo, just change the data in 0306 (do this in the tempo section). Sometimes the keys bounce; you can eliminate this effect by not entering notes held less than or equal to one unit of time.

**Type of Note or Rest**

Memory byte 01B1 is used to store timing information for the last note or rest just hit. If the most significant bit of data in 01B1 is 0, then the data refers to a note. If the most significant bit of 01B1 is 1, then the data refers to a rest.

The lower four bits of data in 01B1 tell the time code. If the lower four bits equal hexadecimal 0, then the note is too short to enter; if the lower four bits equal hex 2 we have a 1/16 note; hex 3 indicates a 1/8 note; hex 4 is a 1/4 note; hex 5 is a 1/2 note; and hex 6 is a whole note. The previous comments also apply to rest time codes, except 1/16 rests, which are ignored. For example, if location 01B1 = 04, then this indicates a 1/4 note, and if 01B1 = 84, we have a 1/4 rest.

The time code to store in 01B1 is determined as follows: Read the timer count in 03FF (this tells you the number of unit times that have elapsed). If this time is less than or equal to 01 (hex), then load 01B1 with 00 (time too short); if 03FF is less than or equal to 08 and greater than 01, then load 01B1 with 02 (to indicate a 1/16 note); if the data in 03FF is less than or equal to 10 and greater than 08, load 01B1 with 03 (code for 1/8 note); if the data in 03FF is less than or equal to 20 but greater than 10, load 01B1 with 04 (1/4 note); if 03FF is less than or equal to 40 but greater than 20, load 01B1 with 05 (1/2 note); if 03FF is greater than 40, load 01B1 with 06 (whole note).

The above codes apply for rests also (except the most significant bit in 01B1 must be 1 instead of 0).

**Vertical Shift Determination**

The first part of this section (from 0390 to 0399) checks the most significant bit of location 01B1 to determine if you just timed a note or a rest. If you timed a rest, immediately jump to the Rest Entry section and bypass the bulk of Vertical Shift Determination.

To vertically shift a note, you must modify the contents of locations 0086, 0087, 0089 and 008A in the Enter Character Cell section. For example, to shift one scan line down, you must add 20 (hex) to locations 0086 and 0089 (and if there is a carry, you must add 01 to locations 0087 and 008A as well).

To shift vertically on the staff from middle C to middle B (a half step) requires shifting down by two scan lines, and thus you must add 40 (hex) to locations 0086 and 0089 (and increment 0087 and 008A if a carry results). To shift down one octave requires shifting down by 14 scan lines, and thus you must add 20 (hex) to 0086 and 0089 14 times with appropriate carry treatment of 0087 and 008A. This is equivalent to adding C0 to 0086 and 0089 and 01 to 0087 and 008A.

*Photo 6. Overall packaged system.*

*Listing 2. Transcriber program.*

Once the listings are loaded into memory, load 00F1 = 00, load 0100 as the starting address, and hit Go on the KIM 1. The staff lines and treble cleff symbol will appear and you are ready to enter notes. Also be sure the interrupt switch added to the TVT board is on. Finally, be sure 1701 = 00 (direction of Port A is defined as an input).

```
Clear Display Memory

0030  LDX  A2  08         X register is a counter multiplier.
0032  LDA  A9  00         Load Acc. with clear data.
0034  LDY  A0  00         Y register is a counter up to 256.
0036  STA  8D  00  04     Store clear data in memory byte.

0039  INC  EE  37  00     Next memory byte.
003C  DEY  88             Decrement counter.
003D  BNE  D0  F7         Counter zero? No. Go to 0036
003F  DEX  CA             Yes. Decrement counter multiplier.

0040  BEQ  F0  06         All cleared? Yes. Go to 0048.
0042  INC  EE  38  00     No. Increment hi-order memory location.
0045  JMP  4C  32  00     Jump to clear next 256 bytes.
0048  LDA  A9  04         Restore original starting point of
                          display memory.
004A  STA  8D  38  00

Load Staff Bars

004D  LDA  A9  FF         Load Acc. with bar data.
004F  LDX  A2  1F         X register is a counter for line position.
0051  STA  9D  E0  05     Enter data for bar in memory.
0054  DEX  CA             Next memory byte.

0055  BNE  D0  FA         Line finished? No. Go to 0051.
0057  LDA  AD  52  00     Yes. Prepare for next bar line.
005A  CLC  18
005B  ADC  69  80

005D  STA  8D  52  00
0060  BCC  90  03
0062  INC  EE  53  00
0065  LDA  A9  08         Finished last line?

0067  CMP  CD  53  00
006A  BNE  D0  E1         No. Go to 004D.
006C  JMP  4C  73  00     Yes. Go to 0073.
006F  NOP  EA             006F to 0072 for future use.

0070  NOP  EA
0071  NOP  EA
0072  NOP  EA
0073  LDA  A9  05         Restore starting memory locations.

0075  STA  8D  53  00
0078  LDA  A9  E0
007A  STA  8D  52  00
007D  RTS  60             Return.

Enter Character Cell

0080  LDY  A0  20         Load Y with # of rows in cell.
0082  LDA  AD  00  02     Load Acc. from data storage area.
0085  ORA  1D  00  04     Superimpose data of 1st row over staff lines.
0088  STA  9D  00  04

008B  DEY  88             Next row.
008C  BEQ  F0  1A         Finished? Yes. Go to 00A8.
008E  INC  EE  83  00     No. Get next data byte.
0091  CLC  18             Move to next line down in display memory.

0092  LDA  AD  86  00
0095  ADC  69  20
0097  BCC  90  06
0099  INC  EE  87  00
```

If in Vertical Shift Determination you learn from 01B1 that you just timed a note, you first see if the highest note on the keyboard (highest C) was hit. If so, store 00 in locations 01B2 and 01B3. These two locations hold the shift data to be added to 0086 and 0089 and 0087 and 008A, respectively. By putting 00 in 01B2 and 01B3, you indicate no shifting (highest C is at the top and doesn't need to be shifted down). If highest C was not hit, check to see if the next lowest note (high B) was hit. If so, store 40 in 01B2 (add 20 twice) and store 00 in 01B3.

If high B was not hit, continue down the keyboard checking for the note that was hit. For every step down the staff the note represents, add 40 (hex) to 01B2 and increment 01B3 if there is a carry. For example, to go from highest C to high B is a step down the staff; to go from high B to high B flat is no step down the staff; to go from high B flat to high A is another step down the staff.

Also, when you find what note was hit, store 01 in location 01B5 if it is a black key and 00 if it is a white key.

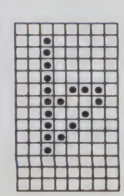
### Flat Entry

Here you check location 01B5 to see if a black (flatted note) was hit. If not, go directly to Note Entry. If a flatted note was hit, prepare to enter the flat symbol, enter it, increment the X register (move the screen pointer right one cell) and then go to Note Entry.

Be aware that the relative location of a flat symbol within the character cell is different from the relative location of a note symbol, and therefore the amount of vertical shifting for flat symbols is different from that for notes (see Note Entry and Fig. 5).

### Note Entry

You have several decisions to make here before the note symbol can be entered properly. First, determine the type of note based on data in 01B1 (i.e., 1/4 note, 1/2 note, etc.). Then determine if the note is in the upper or lower half of the staff. Notes (other than whole notes) in the upper half of the staff have vertical bars pointing down ( ); those in the lower half of the staff (except for whole notes) have vertical bars pointing up ( ). You arbitrarily choose notes above



FLAT SYMBOL

*Fig. 5. Relative vertical position of flat symbol.*

# Goodies from GALACTIC

*Specialty Programs for*

TRS-80 Model I - II - III

### EDAS 4.0 (Editor/Assembler)

This is the highly acclaimed *"USER ORIENTED"* Assembler for the TRS-80 Model II by GALACTIC. Loaded with features such as assemble to memory, block move, link to debugger, default filenaming, reverse video editing, warm start entry and much more. Now the programmer can write, assemble, test, and debug his code without ever leaving EDAS.

EDAS 4.0 with complete manual (120 pages)

Model II Version .................. Was $229.00
**NOW ONLY $179.00**

### MASS/MAIL SYSTEM

This is the NAME and ADDRESS system for subscription control or large mailing lists. It will handle up to 10,500 records, with a worst access time of less than 15 seconds and usual access of less than one second. All adds, deletes, and edits are instant for the operator and are then completed later in a "batch monitor". Extensive documentation and ongoing support. Requires TRS-80 Model II and 2 disk drives minimum. Contact GALACTIC direct for detailed specifications and prices for your exact needs.

Model II Version ........ Contact GALACTIC for Price

### STOCK MARKET MONITOR

This day to day market monitor is designed for the active trader. The system will track the performance of an issue against the market as well as against itself. The package comes with complete documentation and explainations of the formulas that are used by the program. The system is available for the Model I and the Model III TRS-80.

Model I and III cassette version ........... $89.00
Model I and III disk version .............. $99.00

### INVENTORY MASTER

Tired of being a slave to an out-of-control inventory? Let GALACTIC'S INVENTORY MASTER put you in control of your inventory. INVENTORY MASTER operates on a TRS-80 Model I and Model III 48K disk system (Minimum of 2 drives with capabilities of up to 4 drives). Drive spanning capabilities allow you to track 2700 inventory items with a 4 drive system (5100 items for the Model III). Unique machine language sort allows for instantaneous item insertion (approx. 15 seconds with 2700 items in system). Item access can be immediate using system-supplied control numbers. Modeled after a proven main-frame system costing tens of thousands of dollars. Complete add/edit/delete capabilities supported. Placement of orders can be machine-generated as well as user-generated, with editing capabilities. Full report-generator included. Exquisitely documented.

Model I Version ....................... $159.00
Model III Version ..................... $259.00

### MODEL II HOST I/O SYSTEM

From the original author of the TRS-80 HOST and TERM systems in the RADIO SHACK "COMMUNICATIONS PACKAGE". This system allows the full control of the HOST facility by your BASIC program. Set the number of nulls to be sent after a C/R, set a command line to be executed if carrier is lost, turn HOST on and off, switch to channel A or B as desired, enable and disable the ability for the remote terminal to "BREAK" BASIC, identify whether a character came from the HOST'S keyboard or from the REMOTE'S and more. No knowledge of assembler needed. All options may be accessed from BASIC or ASSEMBLER. Complete with detailed documentation. Don't isolate your Model II, Let outside terminals access it's computing power.

Model II with TRSDOS 1.2 ............... $179.00
Model II with TRSDOS 2.0 ............... $199.00

### MAIL/FILE SYSTEM

This is the name, address, phone number data base manager that has set the standard by which other systems are compared. This system contains advanced editing and output capabilities. The TRS-80 Model I system will handle up to 600 records per file, while the Model III version will handle up to 1150 records and the Model II will handle 2500 records per file. All versions are file compatable and maintain constant sort indexes on both NAME and ZIP CODE. International PHONE numbers and ZIP CODES are supported. Thousands of code combinations are available. The Model II version also has a "word processor" type input editor and fast assembler sorting. Complete documentation is included with each version of MAIL/FILE.

Model I Version ....................... $ 99.00
Model III Version ..................... $149.00
Model II Version ...................... $199.00

### ULTRA TREK

This is an all new concept for this type of game, and compares to the others like chess compares to checkers. ULTRA-TREK is a complex, logical game, intended for the serious contestant. It is doubtful that you will ever master this game, but you will certainly enjoy trying! This program requires a TRS-80 Level II, 16K or more. The program is written totally in BASIC and uses 15.5K of RAM.

Model I & Model III Version
(cassette only) ............. $14.95

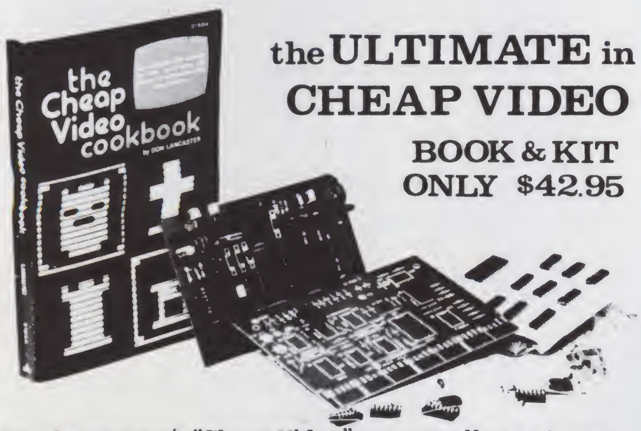
✓301

**galactic software ltd.**
A Division of GS & WS, Inc.
11520 N. Port Washington Rd.
Mequon, Wisconsin 53092
(414) 241-8030

Money Orders & COD's Shipped Within 24 Hours. Checks allow 2 weeks.

# the ULTIMATE in CHEAP VIDEO

**BOOK & KIT ONLY $42.95**




Don Lancaster's "Cheap Video" concept allows almost unlimited options, including:

* Scrolling · Full performance cursor.
* Line/Character formats of 16/32, 24/80, 32/64 .... or almost anything.
* Graphics - up to 256 X 256 B&W; 96 X 128 COLOR (requires low-cost option modules)
* Works with 6502, 6800 and other micros.

SPECIAL OFFER: Buy the Kit (upper case alphanumeric option included) & get the Book at 1/2 price.

✓106 PAIA ELECTRONICS, DEPT. K, 1020 W. WILSHIRE BLVD., OKLAHOMA CITY, OK 73116

I'm Sold, PLEASE RUSH..... ( ) SEND FREE CATALOG
( ) TVT-6 5/8 Kit & Cheap Video Cookbook $42.95
( ) TVT-6 5/8 Kit only (book required for assembly) $39.95
name: ______
address: ______
city: ______ state: ______ zip: ______
PAIA ELECTRONICS, Dept. K 12 1020 WILSHIRE BLVD., OKLAHOMA CITY, OK 73116

# MICROSTAT
## NOW AVAILABLE FOR CP/M*

MICROSTAT, the most powerful statistics package available for microcomputers, is completely file-oriented with a powerful Data Management Subsystem (DMS) that allows you to edit, delete, augment, sort, rank-order, lag and transform (11 transformations, including linear, exponential and log) existing data into new data. After a file is created with DMS, Microstat provides statistical analysis in the following general areas: Descriptive Statistics (mean, sample, and population S.D., variance, etc.), Frequency Distributions (grouped or individual), Hypothesis Testing (mean or proportion), Correlation and Regression Analysis (with support statistics), Non-parametric Tests (Kolmogorov-Smirnov, Wilcoxon, etc.), Probability Distributions (8 of them), Crosstabs and Chi-square, ANOVA (one and two way), Factorials, Combinations and Permutations, plus other unique and useful features.

MICROSTAT requires 48K, Microsoft Basic-80 with CP/M is sent on a single-density 8″ Disk. It is also available on 5″ diskettes for North Star DOS and Basic (32K and two drives recommended), specify which when ordering. The price for Microstat is $250.00. The user's manual is $15.00 and includes sample data and printouts. We have other business and educational software, call or write:

master charge
THE INTERBANK CARD

**ECOSOFT** ✓82
P.O. Box 68602
Indianapolis, IN 46268
(317) 283-8883

* CP/M is a registered trade mark of Digital Research.

✓ Reader Service—see page 257

```
009C  INC  EE  8A  00
009F  STA  8D  86  00
00A2  STA  8D  89  00
00A5  JMP  4C  82  00     Go to enter next line.

00A8  LDA  A9  00         Finished. Restore initial conditions.
00AA  STA  8D  83  00
00AD  STA  8D  86  00
00B0  STA  8D  89  00

00B3  LDA  A9  04
00B5  STA  8D  87  00
00B8  STA  8D  8A  00
00BB  LDA  A9  02

00BD  STA  8D  84  00
00C0  RTS  60             Return.
```

Control Area

```
0100  JSR  20  30  00     Clear display & enter staff lines.
0103  LDX  A2  00         Pointer to leftmost screen position.
0105  LDA  A9  05         Prepare to enter left half of treble cleff.
0107  STA  8D  87  00

010A  STA  8D  8A  00
010D  JSR  20  80  00     Enter left half of treble cleff.
0110  INX  E8             Move pointer right one space.
0111  LDA  A9  20         Prepare to enter right half of treble cleff.

0113  STA  8D  83  00
0116  LDA  A9  05
0118  STA  8D  87  00
011B  STA  8D  8A  00

011E  JSR  20  80  00     Enter right half of treble cleff.
0121  LDA  A9  0E         Change character cell size to 8x14.
0123  STA  8D  81  00
0126  LDA  A9  00         Initialize to indicate note timer, not
                          rest timer.
0128  STA  8D  B1  01
012B  INX  E8             Move pointer one space right.
012C  CPX  E0  20         End of screen?
012E  BCS  B0  0D         Yes. Go to 013D.

0130  LDA  AD  00  17     No. Read key port.
0133  STA  8D  B0  01     Store key data in 01B0.
0136  AND  29  40         Check strobe bit of key data.
0138  BNE  D0  F6         Key hit? No. Go to 0130.

013A  JMP  4C  00  03     Yes. Go to Time Note.
013D  LDA  A9  20         Prepare to clear staff and start over.
013F  STA  8D  81  00
0142  JMP  4C  00  01
```

Time Note

```
0300  LDA  A9  00         Initialize time in 03FF.
0302  STA  8D  FF  03
0305  LDA  A9  30         Set timer. Data in 0306 is our unit of time.
0307  STA  8D  06  17

030A  LDA  AD  00  17     Read key port.
030D  CMP  CD  B0  01     Key released?
0310  BNE  D0  13         Yes. Go to 0325.
0312  LDA  AD  06  17

0315  NOP  EA             Avoid jitter.
0316  NOP  EA
0317  BPL  10  06         One unit of time elapsed? No. Go to 031F.
0319  INC  EE  FF  03     Yes. Increment data in 03FF.

031C  JMP  4C  05  03     Go set timer and keep timing.
031F  NOP  EA             Avoid jitter.
```

high C to be in the upper half of the staff while high C and below are in the lower half.

Next, you need to add flags to a 1/8 or 1/16 note if it is in the lower half of the staff. Those 1/8 or 1/16 notes in the upper half of the staff do not need flags added on to them because the flags are contained within the note data cell.

This is more easily seen pictorially in Fig. 6. To add a flag to a lower half of staff 1/8 or 1/16 note, first enter a lower half of staff 1/4 note, increment the X register (move the pointer right one space) and then enter the flag.

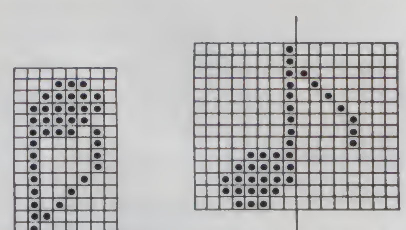
Fig. 6 shows that the relative vertical position of upper and lower half of staff notes (other than whole notes) is different. This means that when preparing to enter notes, you must allow for a different vertical shift, depending on whether the note is in the upper or lower half of the staff. If the note is in the lower half, it must be shifted vertically up by eight scan lines. This is accomplished in lines 10F2 and 10F5, for example.

Also, be aware that the relative vertical position of the flat symbol is different from note symbols (see Fig. 5). With respect to the upper half of staff notes (other than whole notes), the body of the flat symbol is four scan lines lower than the body of the upper half of staff note. Therefore, upon entry, notes must be shifted four scan lines down; that is, the vertical shift data stored in 01B2 and 01B3 is based on the entry of a flat symbol. This data in 01B2 and 01B3 must be modified for note entry. You modify this in the subroutine Note Shift from 12F0 to 1304.

### Bars on Notes

After all the previous steps of Note Entry are completed, you must check if the note entered was above or below the staff lines (i.e., if it was higher than *high G or lower* than middle D flat). If so, you must add horizontal bars to the note.

For example, a middle C half note gets one horizontal bar added (), a low A half note gets two bars (), and so on. There is a subtlety associated with adding horizontal bars to notes. If the note just entered is a lower half of staff note with flags, the X reg-



UPPER HALF OF STAFF 1/8 NOTE

LOWER HALF OF STAFF 1/8 NOTE (i.e., LOWER HALF OF STAFF 1/4 NOTE AND 1/8 FLAG ADDED ON IN NEXT CELL)

*Fig. 6. Flags on upper and lower half of staff notes.*

ister is now pointing to the cell containing the flags. In order to add horizontal bars to the note, you must move the pointer left one cell (decrement the X register) so that you are now pointing to the note cell, not the flag cell (see 11A9 and the next few lines following it).

### Time Rest

Having entered a note, proceed to this section and time the rest between the previous note and the next. This section is identical to the Time Note section, except you set the timer and keep timing until a key is hit. In Time Note, you set the timer and keep timing until a key is released.

The first two lines of this section (1200 and 1202) store 1 in the most significant bit of location 01B1 to indicate you are now timing a rest. The number of unit times elapsed is again stored in 03FF, and from Time Rest you go to Type of Note or Rest to store the time code in the lower four bits of 01B1.

### Rest Entry

Rest Entry is much easier than Note Entry, because there is no variation in vertical position for rests (notes vary vertically depending on what key was hit). You enter 1/8 and 1/4 rest symbols just as note symbols, but 1/2 and whole rest symbols are so small that they are entered directly by storing 3E hex (a small horizontal bar) in the appropriate memory byte (see lines 1276, 1278, 1289 and 128B).

### Tempo

Tempo lets you set the unit time interval in location 0306 and 120B via the keyboard.

Assume 0306 and 120B contain some number (it must be between 01 and 7F) representing the unit time code. This is the number from which the timer counts down *to zero, representing one* unit of time elapsed. Also assume you are bypassing Time Rest and Rest Entry, so that only notes are being timed and entered.

As you play the keyboard, Time Note will store in 03FF the number of unit times elapsed for the last note hit. This time in 03FF is the number of previous unit times elapsed (based on data in 0306 and 120B). You want to change 0306 and 120B so that the new unit time stored in them will make the time in 03FF represent a 1/4 note. In other words, the last note you hit will be the tempo of a 1/4 note after Tempo makes the necessary changes to 0306 and 120B.

Suppose the old tempo data in 0306 and 120B makes the time elapsed in 03FF for the last note hit a *1/2 note* (*i.e.*, the data *in* 03FF is between 20 and 40 hex). Then you must multiply the time in 0306 and 120B by 2. This will have the effect of dividing the data in 03FF by 2 (putting the data between

```
0320   NOP   EA
0321   NOP   EA

0322   JMP   4C   0A    03    Go to read key port.
0325   JMP   4C   30    03    Go to Type of Note or Rest.
```

Type of Note or Rest

```
0330   LDA   A9   01          Load Acc. with time of bounced note.
0332   CMP   CD   FF    03    Is note greater than this time?
0335   BCC   90   03          Yes. Go to 1/16 note check.
0337   JMP   4C   00    12    No. Go to Time Rest (note bounced).

033A   LDA   A9   08          Load Acc. with 1/16 note time.
033C   CMP   CD   FF    03    Is note greater than this time?
033F   BCC   90   0E          Yes. Go to 1/8 note check.
0341   JSR   20   84    03    No. Prepare 01B1 for 1/16 time code.

0344   LDA   A9   02
0346   ORA   0D   B1    01
0349   STA   8D   B1    01
034C   JMP   4C   90    03    Go to Vertical Shift Determination.

034F   LDA   A9   10          Load Acc. with 1/8 note time.
0351   CMP   CD   FF    03    Is note greater than this time?
0354   BCC   90   08          Yes. Go to 1/4 note check.
0356   JSR   20   84    03    Prepare 01B1 for 1/8 time code.

0359   LDA   A9   03
035B   JMP   4C   46    03
035E   LDA   A9   20          Load Acc. with 1/4 note time.
0360   CMP   CD   FF    03    Is note greater than this time?

0363   BCC   90   08          Yes. Go to 1/2 note check.
0365   JSR   20   84    03    No. Prepare 01B1 for 1/4 time code.
0368   LDA   A9   04
036A   JMP   4C   46    03

036D   LDA   A9   40          Load Acc. with 1/2 note time.
036F   CMP   CD   FF    03    Is note greater than this time?
0372   BCC   90   08          Yes. Go to whole note check.
0374   JSR   20   84    03    No. Prepare 01B1 for 1/2 time code.

0377   LDA   A9   05
0379   JMP   4C   46    03
037C   JSR   20   84    03    Prepare 01B1 for whole time code.
037F   LDA   A9   06

0381   JMP   4C   46    03
0384   LDA   A9   80          Subroutine to prepare 01B1.
0386   AND   2D   B1    01
0389   STA   8D   B1    01

038C   RTS   60               Return.
```

Vertical Shift Determination

```
0390   LDA   A9   80          Did we just time a note?
0392   AND   2D   B1    01
0395   BEQ   F0   03          Yes. Go to 039A.
0397   JMP   4C   30    12    No. Go to Rest Entry.

039A   LDA   A9   00          Initialize to indicate non-flatted note.
039C   STA   8D   B5    01
039F   STA   8D   B3    01    Initialize hi-order shift data.
03A2   STA   8D   B2    01    Initialize low-order shift data.

03A5   JMP   4C   B7    03    Check for highest C hit.
03A8   LDA   AD   B2    01    Subroutine to prepare shift data.
03AB   CLC   18
03AC   ADC   69   40

03AE   STA   8D   B2    01
03B1   BCC   90   03
03B3   INC   EE   B3    01
```

```
03B6   RTS  60                 Return from shift data subroutine.

03B7   LDA  A9  B4             Was highest C hit?
03B9   CMP  CD  B0  01
03BC   BNE  D0  03             No. Go to update shift data.
03BE   JMP  4C  90  10         Yes. Go to Flat Entry.

03C1   JSR  20  A8  03         Update shift data.
03C4   DEC  CE  B8  03         Was B hit?
03C7   LDA  AD  B8  03
03CA   CMP  CD  B0  01

03CD   BNE  D0  03             No. Go to check for B flat.
03CF   JMP  4C  90  10         Yes. Go to Flat Entry.
03D2   DEC  CE  B8  03         Was B flat hit?
03D5   LDA  AD  B8  03

03D8   CMP  CD  B0  01
03DB   BNE  D0  06             No. Go to update shift data.
03DD   INC  EE  B5  01         Yes. Prepare for flat.
03E0   JMP  4C  90  10         Go to Flat Entry.

03E3   JSR  20  A8  03         Prepare shift data.
03E6   DEC  CE  B8  03         Was A hit?
03E9   LDA  AD  B8  03
03EC   CMP  CD  B0  01

03EF   BNE  D0  03             No. Check for A flat.
03F1   JMP  4C  90  10         Yes. Go to Flat Entry.
03F4   DEC  CE  B8  03         Was A flat hit?
03F7   LDA  AD  B8  03

03FA   JMP  4C  00  10         Out of Ram. Go to 1000.

1000   CMP  CD  B0  01         Was A flat hit (continued).
1003   BNE  D0  06             No. Go to update shift data.
1005   INC  EE  B5  01         Prepare for flat.
1008   JMP  4C  90  10         Go to Flat Entry.

100B   JSR  20  A8  03         Prepare shift data.
100E   DEC  CE  B8  03         Was G hit?
1011   LDA  AD  B8  03
1014   CMP  CD  B0  01

1017   BNE  D0  03             No. Check for G flat.
1019   JMP  4C  90  10         Yes. Go to Flat Entry.
101C   DEC  CE  B8  03         Was G flat hit?
101F   LDA  AD  B8  03

1022   CMP  CD  B0  01
1025   BNE  D0  06             No. Go to update shift data.
1027   INC  EE  B5  01         Yes. Prepare for flat.
102A   JMP  4C  90  10         Go to Flat Entry.

102D   JSR  20  A8  03         Prepare shift data.
1030   DEC  CE  B8  03         Was F hit?
1033   LDA  AD  B8  03
1036   CMP  CD  B0  01

1039   BNE  D0  03             No. Go to update shift data.
103B   JMP  4C  90  10         Yes. Go to Flat Entry.
103E   JSR  20  A8  03         Prepare shift data.
1041   DEC  CE  B8  03         Was E hit?

1044   LDA  AD  B8  03
1047   CMP  CD  B0  01
104A   BNE  D0  03             No. Check E flat.
104C   JMP  4C  90  10         Yes. Go to Flat Entry.
104F   DEC  CE  B8  03         Was E flat hit?
1052   LDA  AD  B8  03
1055   CMP  CD  B0  01
1058   BNE  D0  06             No. Go to update shift data.

105A   INC  EE  B5  01         Yes. Prepare for flat.
105D   JMP  4C  90  10         Go to Flat Entry.
1060   JSR  20  A8  03         Prepare shift data.
1063   DEC  CE  B8  03         Was D hit?

1066   LDA  AD  B8  03
1069   CMP  CD  B0  01
```

10 and 20 hex; i.e., a 1/4 note).

In general, then, what Tempo does is read the time elapsed in 03FF based on the previous unit time stored in 0306 and 120B. If 03FF is greater than a 1/4 note (i.e., greater than 20 hex), keep dividing the data in 03FF by 2 until 03FF contains a number between 10 and 20 hex. For every division of 03FF by 2, multiply the data in 0306 and 120B by 2. If 03FF contains data less than a 1/4 note (i.e., less than 10 hex), keep multiplying the data in 03FF by 2 until 03FF contains a number between 10 and 20 hex. For every multiplication of 03FF by 2, divide the data in 0306 and 120B by 2.

Here is how to use Tempo. Hit the stop key on the KIM during normal operation of the whole system. Change the data in line 1200 to 1200 JMP 4C 2B 01 (this will bypass Time Rest and Rest Entry). Hit the PC key on the KIM and then hit Go. This will resume normal operation (except rests will not appear).

Now play any number of notes on the keyboard until you get the feel of the tempo you want. The length of time you hold the last key hit represents the tempo of your new quarter note. Now hit Stop on the KIM, load 00F1 with 00, load 1292 into the address display on the KIM (the starting address) and hit Go. The screen will appear with the staff lines and no notes. You are ready to play again, with the new tempo all prepared for you in 0306 and 120B by Tempo.

**Future Goals**

The music transcriber system discussed here is only the beginning of what might become known as a "music processor" in analogy with current word processors. For now, the system has demonstrated its feasibility as a powerful tool to aid in music composition. The future developments are mostly a matter of expanding software, but to achieve polyphony, some hardware modification will also be necessary. There is really no limit to the embellishments you can add, but here are the most pressing goals:

- Add measure bars to video display.
- Make several passes over video data to put it into more readable, standard sheet music format.
- Handle notes and rests held longer than a whole note and time notes and rests finer to incorporate dotted notes and rests.
- Add more video display (more than one set of staff lines).
- Transcribe key signatures (enter tune in one key, then let processor transcribe to a different key).
- Store several pages of sheet music in memory and be able to scroll through the pages.
- True polyphony (enter more than single

**AUTOMATED EQUIPMENT INCORPORATED** ✓96

18430 Ward, Fountain Valley, CA 92708

# WE'VE MOVED!

Call Toll-Free for latest low prices!
**1-800-854-7635** Outside CA
**714-963-1414** Inside CA
**1-800-854-7635** Outside Cont. USA
Prices change daily to meet competition.

### TERMINALS

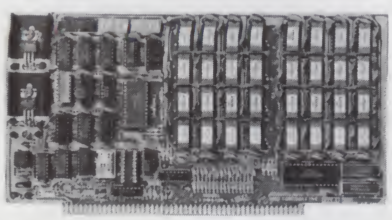
| | |
|---|---|
| TELEVIDEO 912B | $698 |
| TELEVIDEO 912C | 698 |
| TELEVIDEO 920C | 748 |
| NEW TELEVIDEO 950 | 1000 |
| SOROC IQ-120 | 695 |
| ZENITH Z-19 | 735 |
| HAZELTINE 1500 | 850 |


### NORTHSTAR

| | |
|---|---|
| HRZ-1-32K-D | $1990 |
| HRZ-2-32K-D | 2295 |
| HRZ-1-32K-Q | 2450 |
| HRZ-2-32K-Q | 2690 |
| ADDITIONAL 32K RAM | 450 |
| HARD DISC SYSTEM | 3935 |
| 8"DISC DRIVES FOR NORTHSTAR | CALL |
| NORTHWORD | 295 |

### PRINTERS

| | |
|---|---|
| NEC 5510 (TRACT., RIB., THIM) | $2570 |
| NEC 5520 (TRACT., RIB., THIM) | 2900 |
| NEC 5530 (TRACT., RIB., THIM) | 2600 |
| MALIBU | 2295 |
| TI-820 | 1640 |
| ANACOM (SPECIAL) | 990 |
| EPSON MX80 | CALL |
| ANADEX DP-8000 | 795 |
| ANADEX DP-9500 | 1345 |
| XYMEC | CALL |



### SOLID STATE MUSIC

| | KIT | ASM |
|---|---|---|
| CB2 Z80 CPU | $200 | $265 |
| VB1C VIDEO | 140 | 190 |
| VB2 VIDEO | 155 | 210 |
| VB3 VIDEO | 375 | 440 |
| IO4 INTERFACE | 165 | 225 |
| SB1 SYNTHESIZER | 195 | 270 |

### MEASUREMENT SYSTEMS MEMORY

| | |
|---|---|
| DM3200 32K 4MHZ | 480 |
| DM6400 64K 4MHZ | 595 |
| DMB3200 32K 4MHZ BANK SELECT | 630 |
| DMB6400 64K 4MHZ BANK SELECT | 745 |


### DYNABYTE

| | |
|---|---|
| DB 8/1 COMPUTER | $ 2395 |
| DB 8/1 COMPUTER WITH 5" DRIVES | 3900 |
| DB 8/4 DUAL 8" DRIVES | 3030 |
| 32M PHOENIX | 11800 |
| 96M PHOENIX | 18000 |

### ALTOS

| | |
|---|---|
| 64K, ONE MB FLOPPY | 3800 |
| 64K, ONE MB FLOPPY, EXPANDABLE | 5100 |
| 64K, 14.5MG HARD DISK | 8100 |

### MORROW

| | |
|---|---|
| DISCUS 2D 1 DRIVE | 970 |
| DISCUS 2D 2 DRIVE | 1635 |
| DISCUS 2+2 1 DRIVE | 1265 |
| DISCUS 2+2 2 DRIVE | 2245 |
| DISC JOCKEY 2D CONTROLLER | 350 |
| DISCUS M26 HARD DISC | 3990 |
| ADDITIONAL HARD DISC | 3685 |

WE CAN CONFIGURE THE HARD DISC AND FLOPPIES TO WORK WITH N.S. AND OTHER S100 SYSTEMS. CALL FOR DETAILS.

### SOFTWARE

| | |
|---|---|
| WORDSTAR | $350 |
| MAILMERGE | 100 |
| DATASTAR | 250 |
| N.S. PASCAL | 160 |
| MAGIC WAND | 290 |
| CBASIC | 100 |
| BOOKKEEPER | 800 |

ADDITIONAL SOFTWARE DISCOUNTS WITH SYSTEM PURCHASE

| GRAHAM-DORIAN | | STRUCTURED SYS | |
|---|---|---|---|
| JOB COSTING | $700 | ACCTS REC | $700 |
| INVENTORY | 475 | ACCTS PAY | 700 |
| CASH REG | 475 | GEN LEDG | 700 |
| APARTMENT | 475 | PAYROLL | 700 |
| MEDICAL | 700 | INVENTORY | 425 |

### MISC

| | |
|---|---|
| NEC THIMBLES | $ 14 |
| NEC RIBBONS | 6 |
| RS 232 CABLE 5' | 20 |
| RS 232 CABLE 10' | 25 |
| LEDEX MONITOR | 125 |
| NOVATION CAT | 165 |

### DISCS-BOX OF 10

| | | |
|---|---|---|
| VERBATIM 5¼ | 1 SIDE | $27 |
| VERBATIM 5¼ | 2 SIDE | 45 |
| VERBATIM 8 | 1 SIDE | 35 |
| VERBATIM 8 | 2 SIDE | 55 |
| OTHERS | | CALL |
| PLASTIC STORAGE BOXES | | 3 |

**We will try to beat any advertised price.**

**TERMS:** All prices listed are cash discounted and subject to change. COD's are 2% additional. Universities and well rated-firms Net-10.
**SHIPPING:** ADDITIONAL IN ALL CASES.
**TECH. ASSISTANCE:** WE TRY TO HELP INTERFACE AND TROUBLESHOOT—CALL 714-963-1414.
Open Mon.-Fri., 8:00 AM - 5:00 PM Dealer Inquiries Invited.

Our Systems Work!

All systems normally tested and configured in our repair facility before delivery. Service contracts available. Prompt repairs and warranties.

```
106C  BNE  D0  03        No. Check D flat.
106E  JMP  4C  90  10    Yes. Go to Flat Entry.

1071  DEC  CE  B8  03    Was D flat hit?
1074  LDA  AD  B8  03
1077  CMP  CD  B0  01
107A  BNE  D0  06        No. Go to update shift data.

107C  INC  EE  B5  01    Yes. Prepare for flat.
107F  JMP  4C  90  10    Go to Flat Entry.
1082  JSR  20  A8  03    Prepare shift data.
1085  DEC  CE  B8  03    Check next lower octave.

1088  JMP  4C  B7  03
```

Flat Entry

```
1090  LDA  A9  B4        Reset initial conditions for Vertical Shift
1092  STA  8D  B8  03    Determination.
1095  LDA  AD  B5  01    Was flat hit?
1098  BEQ  F0  0D        No. Go to Note Entry.

109A  LDA  A9  40        Prepare for flat entry.
109C  JSR  20  AA  10    Call prepare to enter subroutine.
109F  INX  E8            Move pointer right one space.
10A0  CPX  E0  20        End of screen?

10A2  BCC  90  03        No. Go to Note Entry.
10A4  JMP  4C  3D  01    Yes. Go clear staff and start over.
10A7  JMP  4C  D0  10    Go to Note Entry.
10AA  STA  8D  83  00    Prepare to enter subroutine.
10AD  LDA  AD  86  00    Prepare to enter subroutine (continued).
10B0  CLC  18
10B1  ADC  6D  B2  01
10B4  STA  8D  86  00

10B7  STA  8D  89  00
10BA  LDA  AD  87  00
10BD  CLC  18
10BE  ADC  6D  B3  01

10C1  STA  8D  87  00
10C4  STA  8D  8A  00
10C7  JSR  20  80  00
10CA  RTS  60
```

Note Entry

```
10D0  LDA  AD  B1  01    Was whole note hit?
10D3  CMP  C9  06
10D5  BNE  D0  08        No. Check for 1/2 note.
10D7  LDA  A9  86        Prepare to enter note and enter it.

10D9  JSR  20  F0  12
10DC  JMP  4C  80  11    Go to Bars on Notes.
10DF  LDA  AD  B1  01    Was 1/2 note hit?
10E2  CMP  C9  05

10E4  BNE  D0  17        No. Check for 1/4 note.
10E6  LDA  A9  A8        Note in upper half?
10E8  CMP  CD  B0  01
10EB  BCS  B0  05        No. Go to lower half of staff 1/2 note.

10ED  LDA  A9  78        Prepare and enter upper half 1/2 note.
10EF  JMP  4C  D9  10
10F2  DEC  CE  87  00    Prepare and enter lower half 1/2 note.
10F5  DEC  CE  8A  00

10F8  LDA  A9  6A
10FA  JMP  4C  D9  10
10FD  LDA  AD  B1  01    Was 1/4 note hit?
1100  CMP  C9  04

1102  BNE  D0  17        No. Go check 1/8 note.
1104  LDA  A9  A8        1/4 note in upper half?
```

notes at a time; e.g., chords).

- Provide hard-copy printout.
- Allow transcriber to operate in reverse (play notes stored in memory back through the keyboard).
- Handle left-hand keyboard entry (bass clef).
- Adapt to full 88-note keyboard.

## Conclusions

Producing perfect sheet music in real time is the ultimate goal of music transcription. Even if this goal may never be reached, the music transcriber system is a beginning. From the basics described here, it should be possible to eventually evolve a highly sophisticated music processor, analogous to today's word processors. We may even see written music progress to the point where it will be written in color and three dimensions. Music transcribers will be able to keep pace with such future developments. ■

## References


Hallen, Rod. "PAIA Revisited," *Kilobaud Microcomputing* (October 1979), 40–42.

*KIM-1 User Manual*. Norristown, PA: MOS Technology, Inc., 1976.

Lancaster, Don. *The Cheap Video Cookbook*. Indianapolis, IN: Howard W. Sams, 1978.

*MCS 6500 Microcomputer Family Programming Manual*. Norristown, PA: MOS Technology, Inc., 1976.

*PAIA Digitally Encoded Keyboard Manual (P) 8782A*. Available from PAIA Electronics, 1020 W. Wilshire Blvd., Oklahoma City, OK 73116.

Raskin, Jef. "Using the Computer as a Musician's Amanuensis," *Byte* (April 1980), 18-28.

*Notes*. Available from PAIA Electronics.


Here is a list of costs and suppliers for the building blocks of a music transcriber system:

**KIM-1 microcomputer**
MOS Technology
950 Rittenhouse Road
Norristown, PA 19401
$180

**TVT 6-5/8 video board** (kit)
PAIA Electronics
1020 W. Wilshire Blvd.
Oklahoma City, OK 73116
$45

**PAIA 8782 digitally encoded keyboard** (kit)
$120

**PAIA EK-6 3-octave tone board** (or build your own)
$30

**4K memory board** (build your own)
About $80

**Radio Shack cassette recorder**
About $40

**Power supply** (build or buy)
5 volts at 2 amps, 12 volts at 1/2 amp
About $60

**Modified TV or monitor**
$100 to $250

**Total Cost—$650**

```
1106  CMP  CD  B0  01
1109  BCS  B0  05        No. Go to lower half 1/4 note.

110B  LDA  A9  5C        Prepare and enter upper half 1/4 note.
110D  JMP  4C  D9  10
1110  DEC  CE  87  00    Prepare and enter lower half 1/4 note.
1113  DEC  CE  8A  00

1116  LDA  A9  4E
1118  JMP  4C  D9  10
111B  LDA  AD  B1  01    Was 1/8 note hit?
111E  CMP  C9  03

1120  BNE  D0  3A        No. Check 1/16 note.
1122  LDA  A9  A8        Yes. 1/8 note in lower half?
1124  CMP  CD  B0  01
1127  BCC  90  26        No. Go to upper half 1/8 note.

1129  DEC  CE  87  00    Prepare and enter lower half 1/4 note (for
112C  DEC  CE  8A  00    1/8 or 1/16 note).
112F  LDA  A9  4E
1131  JSR  20  F0  12

1134  INX  E8            Move pointer right one space.
1135  CPX  E0  20        End of screen?
1137  BCC  90  03        No. Continue.
1139  JMP  4C  3D  01    Yes. Clear staff and start over.

113C  DEC  CE  87  00    Prepare and enter flags for lower half
113F  DEC  CE  8A  00    1/8 or 1/16 note.
1142  LDA  A9  B0
1144  JSR  20  AA  10    (don't call 12F0 because then flags are shifted
                         twice).
1147  LDA  A9  B0        Restore lower half 1/8 flag initialization.
1149  STA  8D  43  11
114C  JMP  4C  80  11    Go to Bars on Notes.
114F  LDA  A9  94        Prepare and enter upper half 1/8 or 1/16 note.

1151  JSR  20  F0  12
1154  LDA  A9  94        Restore 1/8 upper half flag initialization.
1156  STA  8D  50  11
1159  JMP  4C  80  11    Go to Bars on Notes.

115C  LDA  AD  B1  01    Was 1/16 note hit?
115F  CMP  C9  02
1161  BEQ  F0  03        Yes. Continue.
1163  JMP  4C  00  12    No. Don't enter note. Go to Time Rest.

1166  LDA  A9  A8        1/16 note in lower half?
1168  CMP  CD  B0  01
116B  BCC  90  08        No. Go to upper half 1/16 note.
116D  LDA  A9  BE        Yes. Prepare and enter lower half 1/16 note.

116F  STA  8D  43  11
1172  JMP  4C  29  11
1175  LDA  A9  A2        Prepare and enter upper half 1/16 note.
1177  STA  8D  50  11

117A  JMP  4C  4F  11
```

Bars on Notes

```
1180  LDA  AD  B0  01    Load Acc. with data of key.
1183  CMP  C9  B4        Was highest C hit?
1185  BNE  D0  0B        No. Go to check next set of notes.
1187  LDA  A9  FF        Yes. Enter two bars above staff.

1189  STA  9D  E0  04
118C  STA  9D  60  05
118F  JMP  4C  00  12    Go to Time Rest.
1192  CMP  C9  B0        Was high B, B flat, A, or A flat hit?

1194  BCC  90  05        No. Go to check for non-barred note.
1196  LDA  A9  FF        Yes. Enter one bar above staff.
1198  JMP  4C  8C  11
119B  CMP  C9  9D        Was non-barred note hit?

119D  BCC  90  03        No. Continue.
```



✓ Reader Service—see page 257

```
119F  JMP  4C  00  12   Yes. Go to Time Rest.
11A2  LDA  AD  B1  01   Was 1/8 or 1/16 note hit?
11A5  CMP  C9  04

11A7  BCS  B0  05       No. Go to check low octave.
11A9  DEX  CA           Yes. Move pointer left one space.
11AA  BPL  10  02       If not off screen, go check low octave.
11AC  LDX  A2  02       Reset pointer to leftmost screen position.

11AE  LDA  AD  B0  01   Load Acc. with key data.
11B1  CMP  C9  93       Was low C, D flat, or D hit?
11B3  BCS  B0  11       No. Go to check next set of notes.
11B5  LDA  A9  FF       Yes. Enter four bars below staff.

11B7  STA  9D  E0  09
11BA  STA  9D  60  09
11BD  STA  9D  E0  08
11C0  STA  9D  60  08

11C3  JMP  4C  E4  11   Go to adjust screen pointer.
11C6  CMP  C9  96       Was low E flat, E, or F hit?
11C8  BCS  B0  05       No. Go to  check next set of notes.
11CA  LDA  A9  FF       Yes. Enter three bars below staff.

11CC  JMP  4C  BA  11
11CF  CMP  C9  9A       Was low G flat, G, A flat, or A hit?
11D1  BCS  B0  05       No. Go to check next set of notes.
11D3  LDA  A9  FF       Yes. Enter two bars below staff.

11D5  JMP  4C  BD  11
11D8  CMP  C9  9D       Was low B flat, B, or middle C hit?
11DA  BCS  B0  05       No. Go to Time Rest.
11DC  LDA  A9  FF       Yes. Enter one bar below staff.

11DE  JMP  4C  C0  11
11E1  JMP  4C  00  12   Go to Time Rest.
11E4  LDA  AD  B0  01   Adjust screen pointer.
11E7  CMP  C9  9D       Was lowest octave hit?

11E9  BCC  90  03       Yes. Continue.
11EB  JMP  4C  00  12   No. Go to Time Rest.
11EE  LDA  AD  B1  01   Was 1/8 or 1/16 note hit?
11F1  CMP  C9  04

11F3  BCS  B0  08       No. Go to Time Rest.
11F5  INX  E8           Yes. Move pointer right one space.
11F6  CPX  E0  20       End of screen?
11F8  BCC  90  03       No. Go to Time Rest.

11FA  JMP  4C  3D  01   Yes. Clear staff and start over.
11FD  JMP  4C  00  12   Go to Time Rest.
```

---

Time Rest

```
1200  LDA  A9  80       Initialize to indicate timing of a rest,
1202  STA  8D  B1  01   not a note.
1205  LDA  A9  00       Clear 03FF of previous time.
1207  STA  8D  FF  03

120A  LDA  A9  30       Load unit of time and start timer.
120C  STA  8D  06  17
120F  LDA  AD  00  17   Read key port.
1212  STA  8D  B0  01   Store data in 01B0.

1215  AND  29  40       Key hit?
1217  BNE  D0  03       No. Continue.
1219  JMP  4C  3A  03   Yes. Go to Type of Note or Rest.
121C  LDA  AD  06  17   Read timer.

121F  NOP  EA           Avoid jitter.
1220  NOP  EA
1221  BPL  10  08       One unit of time elapsed? No. Go read key port.
1223  INC  EE  FF  03   Yes. Increment time in 03FF.

1226  BNE  D0  E2       Very long rest? No. Go start timer.
1228  JMP  4C  26  01   Yes. Don't enter rest. Go read next note.
122B  NOP  EA
122C  JMP  4C  0F  12   Go to read key port.
```

Reader Service—see page 257

Rest Entry

```
1230  LDA  AD  B1  01   Get time code in 01B1.
1233  AND  29  7F       Clear most significant bit.
1235  STA  8D  B1  01
1238  CMP  C9  03       Is this the time of a 1/8 rest or greater?

123A  BCS  B0  03       Yes. Continue.
123C  JMP  4C  2B  01   No. Go read next note.
123F  LDA  A9  03       Is this a 1/8 rest?
1241  CMP  CD  B1  01

1244  BNE  D0  1C       No. Check for 1/4 rest.
1246  LDA  A9  CC       Yes. Enter 1/8 rest.
1248  STA  8D  83  00
124B  LDA  A9  06

124D  STA  8D  87  00   Enter 1/8 rest (continued).
1250  STA  8D  8A  00
1253  LDA  A9  00       Lines 1253 to 1258 are unnecessary but
1255  STA  8D  86  00   are provided for future developments.

1258  STA  8D  89  00
125B  INX  E8
125C  JSR  20  80  00
125F  JMP  4C  2B  01   Go read next note.

1262  LDA  A9  04       Is this a 1/4 rest?
1264  CMP  CD  B1  01
1267  BNE  D0  05       No. Check for 1/2 rest.
1269  LDA  A9  DA       Enter 1/4 rest.

126B  JMP  4C  48  12
126E  LDA  A9  05       Is this a 1/2 rest?
1270  CMP  CD  B1  01
1273  BNE  D0  09       No. Check for whole rest.

1275  INX  E8           Enter 1/2 rest.
1276  LDA  A9  3E
1278  STA  9D  C0  06
127B  JMP  4C  2B  01   Go read next note.

127E  LDA  A9  06       Is this a whole rest?
1280  CMP  CD  B1  01
1283  BEQ  F0  03       Yes. Continue.
1285  JMP  4C  2B  01   No. Go read next note.

1288  INX  E8           Enter whole rest.
1289  LDA  A9  3E
128B  STA  9D  00  07
128E  JMP  4C  2B  01   Goread next note.
```

Tempo

```
1292  LDA  AD  FF  03   Get time of last key hit.
1295  CMP  C9  21       Is time greater than maximum 1/4 note time?
1297  BCC  90  0F       No. Go check minimum 1/4 note time.
1299  CLC  18           Yes. Divide data in 03FF by 2.

129A  ROR  6E  FF  03   Divide data in 03FF (continued).
129D  CLC  18           Multiply data in 0306 and 120B by 2.
129E  ROL  2E  06  03
12A1  CLC  18

12A2  ROL  2E  0B  12
12A5  JMP  4C  92  12   Go check 03FF now.
12A8  CMP  C9  10       Is time less than minimum 1/4 note time?
12AA  BCS  B0  0F       No. Go prepare main program.

12AC  CLC  18           Yes. Multiply data in 03FF by 2.
12AD  ROL  2E  FF  03
12B0  CLC  18           Divide data in 0306 and 120B by 2.
12B1  ROR  6E  06  03

12B4  CLC  18
12B5  ROR  6E  0B  12
12B8  JMP  4C  92  12   Go check 03FF now.
```

```
12BB   LDA   A9   20         Prepare main program for initial clear
                             display, ready to begin anew.
12BD   STA   8D   81   00
12C0   LDA   A9   A9
12C2   STA   8D   00   12
12C5   LDA   A9   80

12C7   STA   8D   01   12
12CA   LDA   A9   8D
12CC   STA   8D   02   12
12CF   LDA   AD   06   03    Check to see if new tempo is valid.

12D2   BPL   10   0B         Too long? No. Go to check if too short.
12D4   LDA   A9   7F         Yes. Enter longest allowed tempo.
12D6   STA   8D   06   03
12D9   STA   8D   0B   12

12DC   JMP   4C   00   01    Exit to beginning of main program.
12DF   BEQ   F0   F3         Too short? Yes. Go enter longest tempo.
12E1   JMP   4C   00   01    No. Exit to beginning of main program.

Note Shift

12F0   STA   8D   83   00    Store low order location of note data.
12F3   CLC   18              Shift down 4 scan lines.
12F4   LDA   AD   B2   01
12F7   ADC   69   80

12F9   STA   8D   B2   01
12FC   BCC   90   03
12FE   INC   EE   B3   01
1301   JSR   20   AD   10    Enter note.

1304   RTS   60              Return.
```

*Listing 3. Vertical display location of various keys.*

Graphics Data

Treble Cleff

| | |
|---|---|
| 0200 | 00 |
| 0201 | 00 |
| 0202 | 01 |
| 0203 | 02 |
| 0204 | 02 |
| 0205 | 02 |
| 0206 | 02 |
| 0207 | FF |
| 0208 | 02 |
| 0209 | 03 |
| 020A | 03 |
| 020B | FF |
| 020C | 08 |
| 020D | 10 |
| 020E | 20 |
| 020F | FF |
| 0210 | 24 |
| 0211 | 28 |
| 0212 | 20 |
| 0213 | FF |
| 0214 | 10 |
| 0215 | 08 |
| 0216 | 03 |
| 0217 | FF |
| 0218 | 00 |
| 0219 | 0E |
| 021A | 1E |
| 021B | 14 |
| 021C | 10 |
| 021D | 09 |
| 021E | 06 |
| 021F | 00 |
| 0220 | 70 |
| 0221 | 88 |
| 0222 | 08 |
| 0223 | 08 |
| 0224 | 08 |
| 0225 | 10 |
| 0226 | 20 |
| 0227 | FF |
| 0228 | 80 |
| 0229 | 00 |
| 022A | 00 |
| 022B | FF |
| 022C | 80 |
| 022D | 40 |
| 022E | 40 |
| 022F | FF |
| 0230 | 50 |
| 0231 | 48 |
| 0232 | 48 |
| 0233 | FF |
| 0234 | 48 |
| 0235 | 50 |
| 0236 | 60 |
| 0237 | FF |
| 0238 | 40 |
| 0239 | 40 |
| 023A | 40 |
| 023B | 40 |
| 023C | 80 |
| 023D | 00 |
| 023E | 00 |
| 023F | 00 |

Flat Symbol

| | |
|---|---|
| 0240 | 00 |
| 0241 | 20 |
| 0242 | 20 |
| 0243 | 20 |
| 0244 | 20 |
| 0245 | 2E |
| 0246 | 32 |
| 0247 | 24 |
| 0248 | 28 |
| 0249 | 30 |
| 024A | 20 |
| 024B | 00 |
| 024C | 00 |
| 024D | 00 |

Lower half 1/4 note

| | |
|---|---|
| 024E | 01 |
| 024F | 01 |
| 0250 | 01 |
| 0251 | 01 |
| 0252 | 01 |
| 0253 | 01 |
| 0254 | 01 |
| 0255 | 01 |
| 0256 | 01 |
| 0257 | 0F |
| 0258 | 1F |
| 0259 | 3F |
| 025A | 3E |
| 025B | 1C |

Upper half 1/4 note

| | |
|---|---|
| 025C | 00 |
| 025D | 1C |
| 025E | 3E |
| 025F | 7E |
| 0260 | 7C |
| 0261 | 78 |
| 0262 | 40 |
| 0263 | 40 |
| 0264 | 40 |
| 0265 | 40 |

```
0266    40
0267    40
0268    40
0269    40

Lower half 1/2 note
026A    01
026B    01
026C    01
026D    01
026E    01
026F    01
0270    01
0271    01
0272    01
0273    0F
0274    11
0275    21
0276    22
0277    1C

Upper half 1/2 note
0278    00
0279    1C
027A    22
027B    42
027C    44
027D    78
027E    40
027F    40
0280    40
0281    40
0282    40
0283    40
0284    40
0285    40

Whole note
0286    00
0287    3C
0288    42
0289    81
028A    42
028B    3C
028C    00
028D    00
028E    00
028F    00
0290    00
0291    00
0292    00
0293    00

Upper half 1/8 note
0294    00
0295    1C
0296    3E
0297    7E
0298    7C
0299    7A
029A    42
029B    42
029C    42
029D    44
029E    48
029F    50
02A0    60
02A1    40

Upper half 1/16 note
02A2    00
02A3    1C
02A4    3E
02A5    7E
02A6    7E
02A7    7A
02A8    46
02A9    4A
02AA    52
02AB    64
02AC    48
02AD    50
02AE    60
02AF    40

Lower half 1/8 flag
02B0    00
02B1    00
02B2    80
02B3    40
02B4    20
02B5    10
02B6    08
02B7    08
02B8    08
02B9    00
02BA    00
02BB    00
02BC    00
02BD    00

Lower half 1/16 flags
02BE    00
02BF    00
02C0    80
02C1    40
02C2    20
02C3    90
02C4    48
02C5    28
02C6    18
02C7    08
02C8    08
02C9    08
02CA    00
02CB    00

1/8 rest
02CC    00
02CD    00
02CE    00
02CF    00
02D0    32
02D1    3C
02D2    08
02D3    10
02D4    20
02D5    40
02D6    00
02D7    00
02D8    00
02D9    00

1/4 rest
02DA    00
02DB    20
02DC    10
02DD    18
02DE    0C
02DF    18
02E0    30
02E1    18
02E2    0C
02E3    3C
02E4    30
02E5    10
02E6    08
02E7    00
```

# THE AFFORDABLE HOME COMPUTER


# IS NOW ON SALE.

When PMC-80 was first introduced to the United States, the response was overwhelming! The Computer World was ASTONISHED at the QUALITY, as well as the PRICE. In fact, the PMC-80 has almost all the features of America's best selling computer, the TRS-80, but with a price tag of $200.00 less! (SIMUTEK'S price is $275.00 less!)

**Microsoft's Level II Basic and 16K Memory.**

Another reason for all the commotion is that the PMC-80 uses the same, easy to learn, LEVEL II BASIC language that the TRS-80 uses! What does this mean? It means that the PMC-80 can run all the 1000's of programs that have been written for the TRS-80 Level II, 16K computer! Some of the programs available include: Flight simulation, World Champion Chess program, Scores of educational and business programs. Word processing programs and hundreds of other games and simulations.

**The PMC-80 is expandable!**

Your PMC-80 is ready to grow with your needs. Using a special cable, available from Simutek for $35.00, it may be connected to Radio Shack's Expansion interface, to give you up to 48,000 characters of memory, up to 4 disk drives, addition of a telephone communication system, Voice Synthesizer, various printers, a real time clock, as well as plotters and other neat interfaces! As your skills with the PMC-80 improve, you're sure to want some of the ADD-ON's described above. (And these are just a few!)

**Save Money! Use your own television!**

The PMC-80 has a built in RF MODULATOR so you can use your black and white or color TV for a VIDEO MONITOR! A simple hook-up to your television's antenna connector, makes channel 3 your computer's video channel.

**Special Introductory Offer: 25 Free Programs**

SIMUTEK, a leading innovator in Home Computer Software, is making a SPECTACULAR INTRODUCTORY OFFER

**Comparison Chart**

| Features | PMC-80 | TRS-80 |
|---|---|---|
| Microsoft's Fantastic Level II Basic | Yes | Yes |
| Full 128 x 48 Graphics | Yes | Yes |
| 16,000 characters memory | Yes | Yes |
| Tape recorder for storing or retrieving programs | Yes | Yes |
| Use your own TV (Save $$) | Yes | No |
| Expandable to 48,000 characters of in computer memory | Yes | Yes |
| Use TRS-80 expansion interface | Yes | Yes |
| Expandable to 4 floppy disk drives (over 100,000 characters of storage on each one!) | Yes | Yes |
| Telephone Communications available: connect to large computers/electronic mail etc | Yes | Yes |
| 1000's of ready made programs availble for "educational" and "scientific" applications? | Yes | Yes |
| Printers available | Yes | Yes |
| High Speed Z80 CPU | Yes | Yes |
| Interface available for controlling lights and appliances in home | Yes | Yes |
| **Retail Price** | **$645.00** | **$849.00** |

to people that ORDER the PMC-80 NOW. With each purchase, we will give 25 FREE HOME COMPUTER PROGRAMS! Some of these include: Home Amortization tables program, Loan payment programs, Depreciation rate program, Interest table program, Annuity and Investment calculation programs as well as these great animated games: GRAPHIC-TREK 2000: Command the Enterprise!, INVASION WORG. Stop the invading marauders from space before they take over earth! You command Earth's forces of androids, space fighters, laser guns etc., against the enemy's robots, saucers, proton destroyers, etc!, STAR WARS: Fly your space fighter into the Death Star to destroy it! But watch out, Darth Vader doesn't like you!, SPACE TARGET: A fantastic animated arcade game of skill and daring!, SAUCERS: Can you win win the coveted Medal of Honor?

**Here's what you get:**

The PMC-80 microcomputer with 16,000 characters of "In Computer Memory", Microsoft's Level II Basic (built into the computer), a cassette player for storing or retrieving programs or data (cassette player is built into the computer!), an RF Modulator for connecting the PMC-80 to your television set, 25 FREE programs so you start using your computer immediately, complete instruction manual, learning manual and owners manual so you can begin writing your own programs right away!

Best of all, you have the chance to use the PMC-80 in your own home before making your final commitment! Keep it for two weeks, if, for any reason you decide not to become a PMC-80 owner simply send it back, (in new condition please), and we will promptly refund the full amount, including your delivery charge!

Time is of the essence. Please order now, as this price can only be guaranteed through December 25, 1980.

**Order Now Save $76.00**

Credit card holders may use our TOLL FREE NUMBER. Or send check for $569.00 plus $6.00 delivery. (Arizona residents add $23.80 state tax). Please mention this magazine. (No tax on out of state orders).

**Call Toll Free 800-528-1149**

In Arizona call 602-886-5880 Collect

**SIMUTEK** ✓12
**COMPUTER PRODUCTS**™
9881 E. Skyview Drive
Tucson, AZ 85710

# A Simple Voltage-Controlled Synthesizer

*Using a powerful sound generator chip from Texas Instruments, this easy-to-build device is both modular and expandable.*

*Dennis Bathory Kitsz*
*Roxbury, VT 05669*

Inevitably the day will come when you will want to play electronic music—not program it, not assemble it, but play it. At that crucial moment you will learn precisely how versatile your microcomputer is as a performing instrument.

But isn't the program your preparation for playing the composition? Certainly it might be, but whether it really is remains open to question, because performance involves an uncomfortably substantial quantity of the unknown. Power can fluctuate, and with it a program may disappear. Temperature can change suddenly or subtly, and with that the tuning may go astray. Performing musicians may get lost, sprint ahead or introduce unexpected bends in the rhythm. And the very nature of performance involves creative improvisation, something as yet unheard of in computerdom.

These dilemmas are not new, and each of the recent generations of sound production chips has attempted to handle them differently. Computer-bus-compatible devices, such as the General Instrument and Texas Instruments integrated circuits, can be rock stable under crystal timing, but suffer from a distinct inability to retune unless clocked by temperature-sensitive oscillators. Moreover, a lost program renders these chips useless.

On the other hand, analog processors are subject to tuning vagaries and, more than any other weakness, do not permit consistently accurate reproduction of the timbre and envelope scored by the composer.

This article describes the construction of a basic modular synthesizer using the SN76477 complex sound generator made by Texas Instruments. This sound generator is an analog unit, and thus suffers from many of the deficiencies of the genre, but it can be used, if needed, without the help of a computer. Furthermore, the synthesizer is modular and can be expanded with filters and keyboards into a stand-alone unit with unlimited voices; or, up to 16 units can be run by a microcomputer such as the TRS-80.

The heart of the device, the SN76477 sound chip, was designed by TI using traditional analog synthesizer architecture. It contains two voltage-controlled oscillators, one for pitch and the other for modulation; an envelope with variable attack, sustain

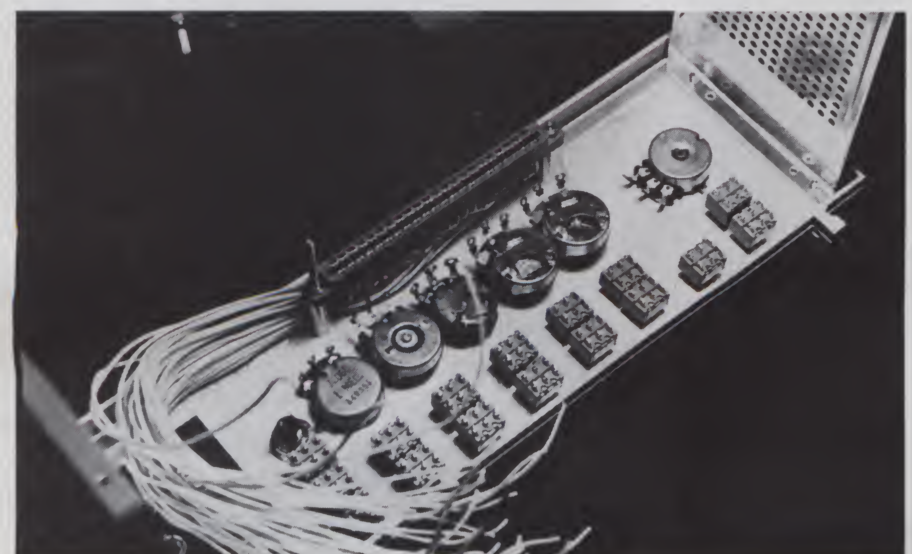
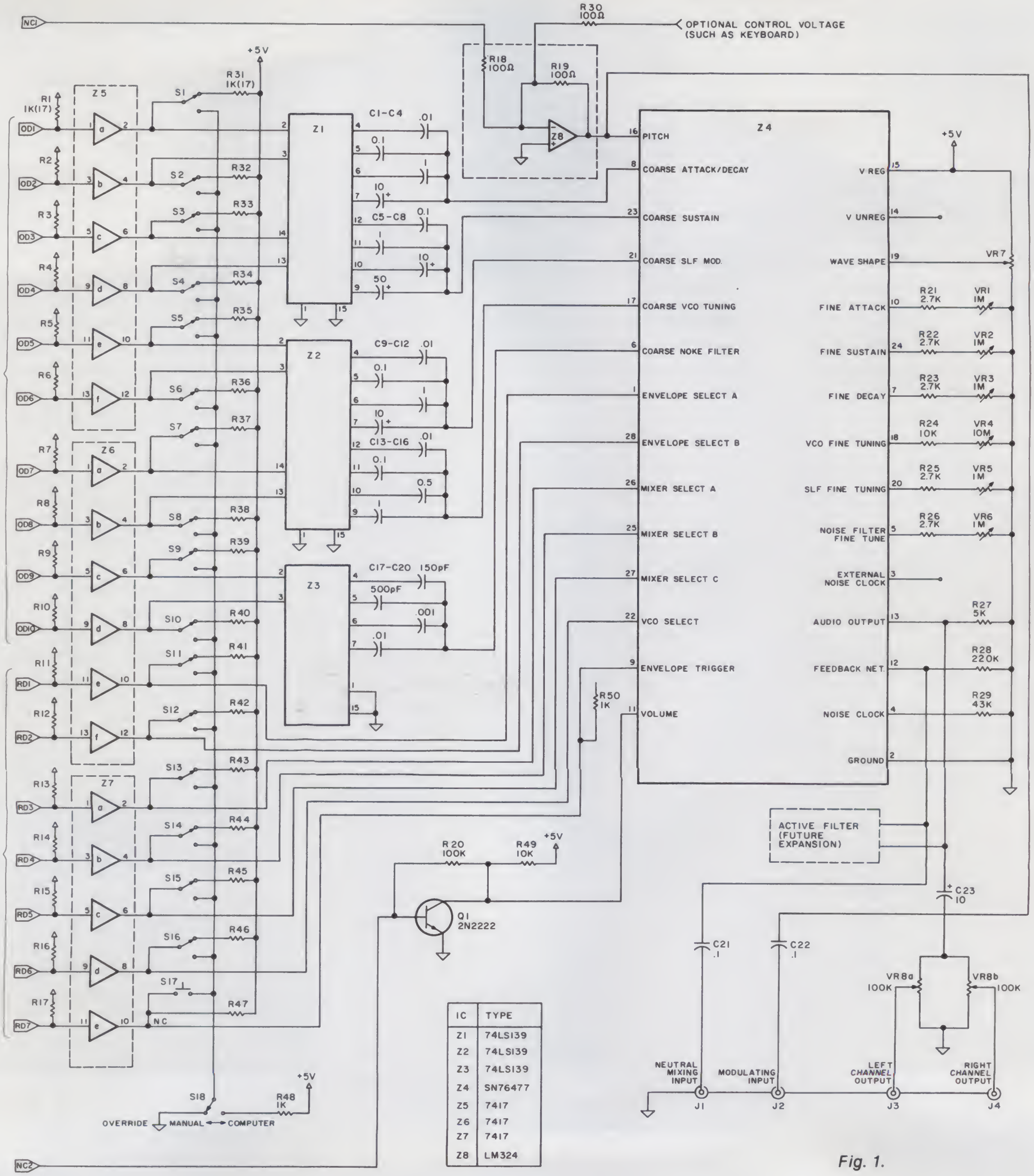


*Photo 1. Synthesizer components mounted in place before wiring.*




| IC | TYPE |
|---|---|
| Z1 | 74LS139 |
| Z2 | 74LS139 |
| Z3 | 74LS139 |
| Z4 | SN76477 |
| Z5 | 7417 |
| Z6 | 7417 |
| Z7 | 7417 |
| Z8 | LM324 |

*Fig. 1.*

and decay; a noise generator; mixer; input/output; and control logic. It is capable of being interfaced to a keyboard, pedals or other electromechanical control devices; it can be dedicated as a noisemaker or game attachment; and, using simple logic and digital-to-analog conversion, it can be directed by a microcomputer.

Unlike the 8038, former golden boy of sound generator chips, the SN76477 presents only square waves at its output; conversion into sine or triangle (both performed by the 8038) or sawtooth waves, as well as analog filtering functions, are up to the user. And, unfortunately, a voltage-controlled amplifier was not designed into the SN76477, likewise leaving that important function to the user.

### The Circuit

Only the SN76477 chip is needed for a stand-alone synthesizer, but interfacing microcomputer control logic demands a few extra inexpensive integrated circuits. In Fig. 1, Z5, Z6 and Z7 are buffers that permit the logic signals to be fed from the computer. Open-collector circuits are specified so that manual switches can be used when the synthesizer is played without the microcomputer. Ordinary TTL circuits would be damaged if their outputs were shorted to ground for long periods.

The first group of buffered outputs from

Z5 and Z6a–d (or the manual toggle switches) run in pairs to the inputs of the dual two-line to four-line demultiplexers, Z1, Z2 and Z3. These devices interpret the line pairs as binary 00, 01, 10 and 11, selecting one of four outputs for each input number. The selected output swings to ground, thereby switching its respective capacitor into the sound generator's circuit.

Similarly, the second group of buffered outputs (Z6e–f and Z7) includes the logic control lines used for selecting envelope, mixer and other functions. The last of these (S17) is a push button controlling the envelope trigger. The control lines can also be used as sophisticated multiplexers, but that is beyond the scope of this simple unit (see the SN76477 data and applications sheets for details).

A variable-voltage output is fed to pin 16 of the sound generator; the higher the input voltage, the lower the pitch will be. For use with the TRS-80 interface described elsewhere in this issue ("Build a TRS-80-to-Synthesizer Interface," p. 32), or with other positive digital-to-analog converters, the optional inverting DC amplifier (Z8, R18 and R19) may be included. Software can also invert the signal.

The amplitude of the sound generator's output is normally determined by the resistance at pin 11, but by using a second variable-voltage input line and the components including Q1, the volume can be varied by

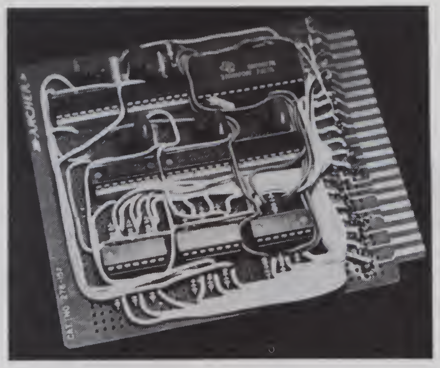


Photo 2. *The wired sound generator board. SN76477 is 28-pin chip at the top right; I used 74LS155 decoders during a shortage of 74LS139s.*

the microprocessor's output signals.

A simple, unaltered input is provided at J1, as well as an input (J2) to modulate the voltage-controlled oscillator at pin 16. The chip has an internal operational amplifier, and active filtering of the waveform can be inserted in the feedback network accessible at pin 12. A sine/triangle/ramp converter might also be included before the final output. Performance-time controls (VR1 to VR8) are for attack, sustain, decay, tuning, waveshape, noise and panning across two stereo channels (J3 and J4).

A well-regulated +5 V is needed at pin 15 to operate the circuit, or a stable +7.5 to +8 V can be applied instead to pin 14. Since +5 V will also be needed to operate the TTL logic, I recommend construction of a single regulated power supply.

The hardware for building the unit is commonplace and not critical, except that the capacitors in the tuning circuits should be high-quality, temperature-stable units. A vernier dial might be used for accurately controlling the VCO potentiometer. Best of all, in terms of simplicity, much of this hardware (such as switches and potentiometers) is optional and entirely dependent on your needs. My prototype (see Photo 1), for example, does not include waveshape or panning controls, but has been expanded with voltage-in and voltage-out jacks.

### Operation

Full use of the sound device requires both computer and manual control. The computer controls are signals from the data bus, latched and fed to the synthesizer; a total of 17 of these are needed for a complete system, but a single, latched, eight-bit data byte will provide enough control information for basic operation of the sound generator.

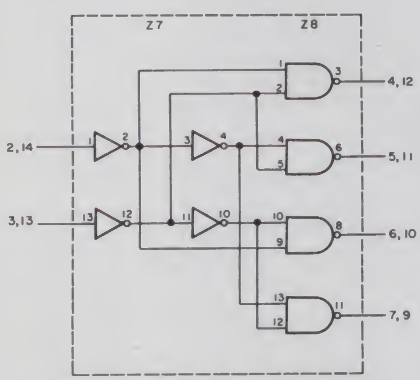
The manual controls—both switches and potentiometers—can be used to activate the unit. A keyboard with a linear voltage output can be input at VC1, and a foot pedal at VC2, thus simulating the analog outputs of the computer interface. You can tune and play the instrument as any monophonic performance synthesizer. A preamplified microphone can be attached to the mixing input, and guitar modulation can be introduced at J2. You can apply the results to an amplifier for a full-featured performing instrument.

### Construction

Because of the increasing number of data and control lines needed for additional synthesizer channels, I recommend modular construction. Each channel should be separately assembled and tested, although a common, well-regulated power supply may feed all the synthesizers.

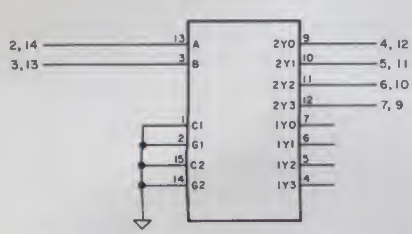
You can use any form of construction for this analog mini-synthesizer, including wire-wrapping and soldered prototyping.

First of all, when you purchase the SN76477 sound chip, be sure to obtain a copy of the data and applications sheets. The number of useful combinations of the 28 pins of this chip exhausts the imagination; you will need these sheets even to set up the simplest sequence of sounds. And don't be distressed by the engineer's habit of using terms such as "system inhibit" when he means "envelope trigger," and so on. All the functions of the SN76477 are




CIRCUIT EQUIVALENT TO ONE HALF OF A 74LS139. Z7 IS A 74LS04, Z8 IS A 74LS00. Vcc IS PIN 14, GROUND IS PIN 7. USE THIS CIRCUIT TO REPLACE OFTEN HARD-TO-FIND 74LS139 IC's

*Fig. 2.*




MORE EXPENSIVE ALTERNATE TO HALF OF A 74LS139. Vcc IS PIN 16, GROUND IS PIN 8

*Fig. 3.*

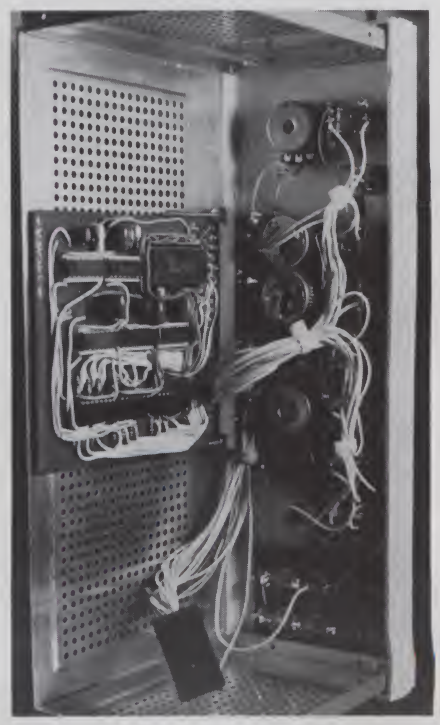


Photo 3. *Completed wiring of the synthesizer. The upper wiring harness goes to switches and controls. A 24-pin socket is connected to the lower wiring harness, serving as the computer-to-synthesizer connection.*

✓Reader Service—see page 257


*Photo 4. The finished synthesizer standing next to TRS-80 keyboard for comparison of size. The unit is housed in a $15 Radio Shack cabinet.*

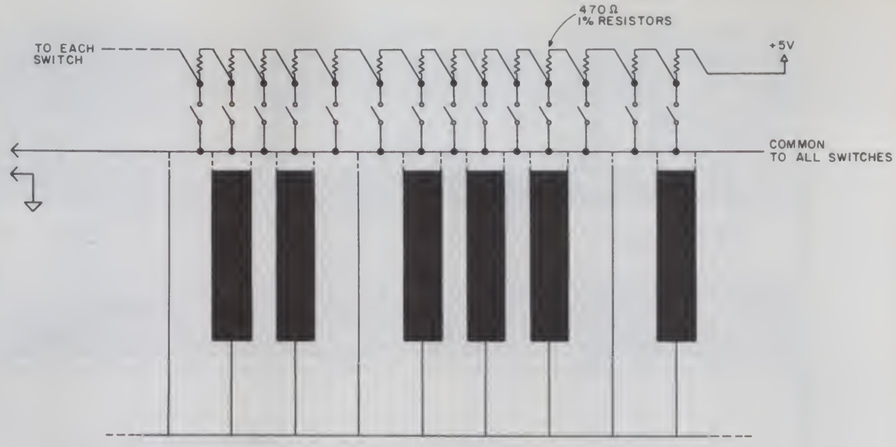



*Fig. 4. Keyboard with simple voltage output.*

similar to those performed by a conventional analog music synthesizer. For convenience, I have relabeled many of the chip's functions on the diagrams for this article.

In Fig. 1, the signals marked RD1 through RD7 are the required data lines for computer control. These signals configure the chip's envelope and mixer combinations, as well as select the voltage-controlled oscillator for output through the system and provide a trigger to the envelope generator. Ten other optional data signals, OD1 through OD10, will also set up the crude ranges of attack and decay, sustain, tuning the voltage-controlled oscillator and low-frequency oscillator and depth of noise filtering.

The TRS-80 synthesizer interface serves as an example. A byte is written to the 8255 programmable peripheral interface, port C, in order to prepare the logic lines. For this synthesizer, the latched data is brought out *directly* from the 8255, bypassing the interface's on-board envelope trigger (represented by the interface circuit's Z8 and Z9). A value for the pitch is written to port A, and a value for volume is written to port B. 256 levels of volume selection are probably sonic-subtlety overkill; since orchestral music only employs 12 levels (pppppp to ffff), then four data lines offer a more luxurious 16 levels. The last four lines of port B may instead be brought out for control of some of the optional data (OD) lines in the synthesizer.

Because of the versatility of this unit, it is difficult to describe its use. Immediately and easily, the synthesizer can output a sequence of pitches; additionally, a quickly alternating (0-1-0) bit sent to the envelope trigger line along with each note will produce a sequence of notes with more character. A subtle pitch-altering software subroutine in machine language can create a level of vibrato to your taste. Selection of noise and the low-frequency oscillator will allow special effects or, in certain combinations, the more realistic simulation of live instruments.

The neutral mixing input (J1) allows insertion of live, recorded or externally generated line-level electronic sounds into the system's output. A signal to the modulating input (J2) will alter the pitch of the VCO corresponding with the level and frequency of that external signal. If you use the inverting buffer (Z8 and related components), you can attach another 100-ohm resistor to the inverting input (junction of R18 and R19), and a second control voltage can be inserted into the system—perhaps the output of a foot pedal.

Lead dress on the boards is not crucial, but for ideal isolation of the chip's two oscillators, shielding is wise for some of the longer control lines running to potentiometers. Take particular care with the wiring of the low-frequency oscillator, which can easily interfere with other signals. The single-channel unit shown in the photographs will take about eight hours to build and test, using discrete wiring and sockets for all ICs, a 44-pin prototyping board, matching edge-card connector and a fancy cabinet.

Although I used a 24-pin socket for connecting this individual unit to the controlling computer, a multi-channel system is best assembled using a motherboard. The address decoder, digital/analog converter, data buffers and latching circuits should then be included on the individual synthesizer boards.

There are many possibilities for performing with this instrument. On a machine like the TRS-80, the 8 × 8 matrix keyboard can easily be paralleled with a standard 64-key musical keyboard (see my September "Applications" column, p. 28, in *80 Microcomputing*). A short software routine could speedily identify each key, separating portions of the sonic spectrum and routing the signals to each mini-synthesizer in turn.

Fig. 4, on the other hand, is a computer-free method of interfacing the unit to a keyboard. Precision resistors divide the voltage into equal proportionate parts in order to feed the synthesizer's voltage-controlled input. Or, as with the software for scanning the 8 × 8 matrix, a hardware separation of the keys might assign a small portion of the entire keyboard to each individual synthesizer. Be warned, though, that tuning such a setup can be remarkably difficult, especially in a performance environment.

**Conclusion**

I have left parts of the description and use of this device largely ambiguous, but be assured that the synthesizer will work exactly as shown in the diagrams. The ambiguity is a necessary result of the number of possibilities left open by the powerful SN76477 complex sound generator. If you need a combination performance/computer-controlled instrument, and if you need it now, then consider this circuit and its companion D/A converter.

If, however, you can wait for technology to develop more advanced devices, then the SN76477 (and all the work you put into wiring it) will likely appear to be a complicated disappointment in less than half a decade. If, moreover, your needs don't include a performance instrument, but merely a programmable one, then consider instead the easily wired and interfaced digital sound generators made by Texas Instruments or General Instrument. ■

✓ Reader Service—see page 257

# Computer Music The Easy Way

*With the Texas Instruments SN76489A sound chip, you can produce three-voice music with your computer. Part 1 describes the hardware involved.*

*Steve Marum*
*520 Talley*
*Sherman, TX 75090*

Many people would like to dabble in computer-generated music but are put off by the expense or effort. Now there's a way. The new SN76489A computer-controlled sound chip from Texas Instruments and ten (or fewer) other ICs will let you put together a three-voice music synthesis system that is easy to program.

In this, the first of two articles, I'll explain the internal workings of the sound chip and the external circuitry required to interface it to your particular processor. A few short BASIC programs will demonstrate the SN76489A and let you play some simple music on it.

The second article will discuss the software aspect of the system, with program listings for 8080/Z-80 systems. This will be a full-blown program capable of handling three voices and taking input in conventional music notation adapted for an alphanumeric keyboard. Since only a short, 60-byte program is written in machine language, with the rest in BASIC, those of you with other processors should have little trouble converting the program to your machine language.

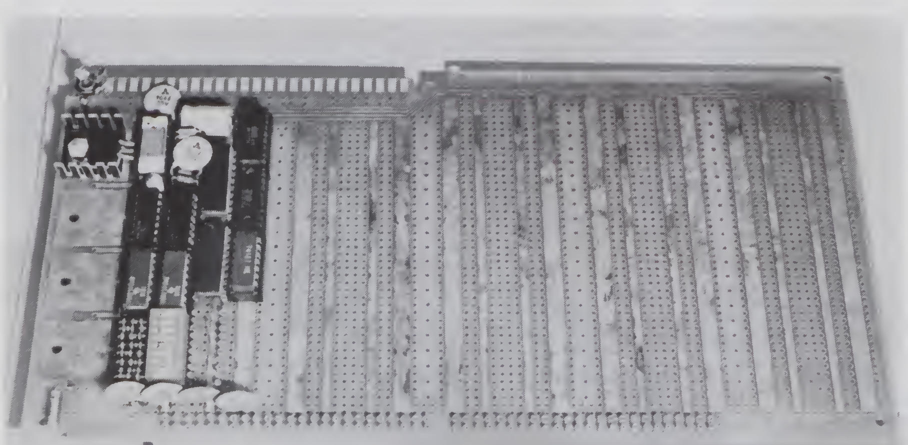


*Photo 1. The music-generating circuitry on an S-100 kludge board. The SN76489A is the white ceramic IC in the upper left corner of the circuit. There is plenty of room left for future expansion.*

### Methods of Computer Music Generation

You can produce music from a computer either by using mostly hardware or mostly software.

The software approach typically uses one or two bits of an I/O port hooked to an amplifier through some resistors. Under program control, the output data can be toggled from high to low and back again, producing a square-wave signal.

A single voice music program to drive this interface is fairly simple to write. All you need is a mainline program to get the frequency and duration of each note and a subroutine to delay a given amount of time. The frequency of the note is converted to the period of the square wave, and the duration is converted to the number of cycles of the given period that will be necessary. All you need are a couple of nested loops, the inner counting down the period and the outer counting the number of cycles.

Adding a second voice to this method produces complications. Now you have two periods to count down simultaneously, each toggling a different output bit when it reaches zero. You also have two durations to count down separately, since the two notes will generally have different lengths. This results in a much longer program. In fact, the increased amount of processing that the computer must handle may limit the tempo at which you can play the songs.

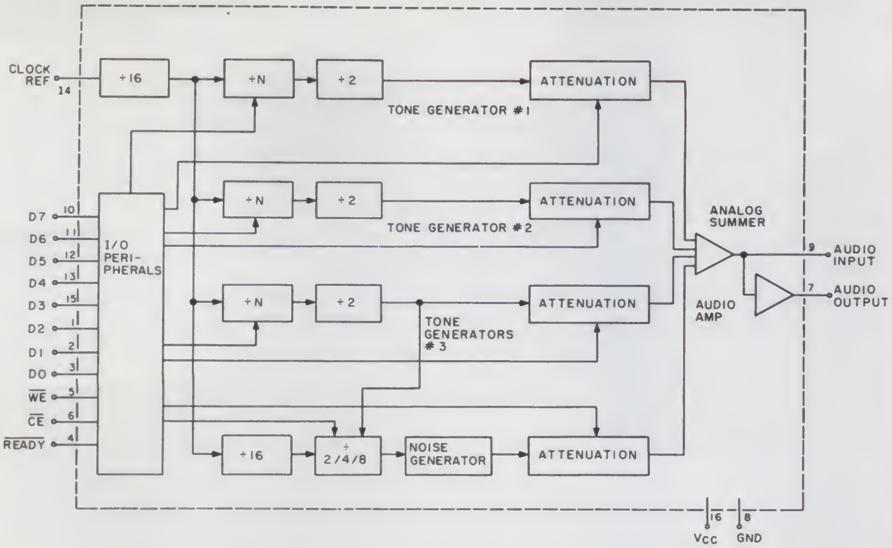



*Fig. 1. The SN76489 computer-controlled sound generator consists of three tone generators and a noise generator. Each generator has an independently controlled attenuator between it and the output, allowing considerable flexibility in mixing sounds. Data is received from the computer over the 8-bit data bus.*

To be fair, the fancier boards also have some means of varying the waveshape of the output signal to something other than a square wave. Unless you are trying to duplicate the sound of another instrument, this is not necessary.

Up until now, the hardware approach has generally used a board-full of TTL to implement each tone generator. To begin with, you must have a programmable divider to take the high frequency clock and count it down to the audio frequency you want. Along with this, you need some latches to hold the data and a means of controlling the volume.

This board removes much of the computational overhead from the processor. Once you have programmed the tone generator to the desired frequency, you can do whatever you want until it's time to change to a new note.

**The SN76489A Approach**

The SN76489A sound chip puts most of the hardware required for three tone generators, plus a noise source, on one chip. Each sound source has its own attenuator, and, using the internal audio amplifier, all the outputs are summed together to drive an external power amplifier. An eight-bit wide bus interface completes the circuitry.

The three tone generators are identical. Each contains a ten-bit programmable down counter. This ten-bit number is loaded by the processor to set the frequency produced. Every time the counter underflows, the borrow pulse is used to reload the counter and toggle the output flip-flop. This produces a square-wave signal.

The ten-bit number provides sufficient resolution to cover five octaves of music. Using the 2 MHz clock from an S-100 system, you can produce notes from two octaves below middle C to three octaves above middle C. This is a wide enough range to cover most sheet music written for the piano.

The noise source is a 15-bit pseudorandom sequence generator that produces white noise. You can set it to any of three fixed rates or control it by tone generator number three if you need more control over the frequency. Thus, it can cover the range from a low-frequency explosion to a high-frequency gunshot. This is most useful for sound effects in games but could be used to simulate a snare drum or cymbals.

Each signal from these four sources has its own attenuator. The attenuators cover the range from full volume to a −28 dB in 2-dB steps. The next step, which would be −30 dB, turns the attenuator off. The logarithmic weighing (2 dB per step) of the attenuators is convenient for the production of music. Turning an attenuator from off to full volume and then ramping the amplitude back to zero in a linear manner over the span of a second produces a sound like a bell.

The audio amplifier follows the attenuators. The four signals from the three tone generators and the noise generator are algebraically summed together and amplified up to a 10 mW level. This signal has a voltage swing of two or three volts but is not capable of supplying much current, so an external amplifier drives the speaker. The signal is padded down 34 dB to be compatible with a microphone input. This lets you

easily record songs on a cassette recorder.

The external amplifier's tone controls give you a little more control of the sound. It's also convenient to have a manual volume control in case the processor becomes stuck. (If the processor is stopped or reset, the sound chip simply continues with whatever you last told it to do.)

The interface to the processor is through an eight-bit-wide data bus. Due to the pin limitations of the 16-pin DIP, all the addressing must be done externally. You tie the chip enable pin to the address decoder and the write enable pin to the read/write line of the computer system bus. Since the SN76489A is slow at accepting the data, a ready output ties to the wait input of the processor. The internal cycle of the SN76489A, which is 16 microseconds using a 2 MHz clock, takes 32 clocks to load the data. Input data must remain stable during this time.

The SN76489A has a twin called the SN76494. The only difference is in the clock

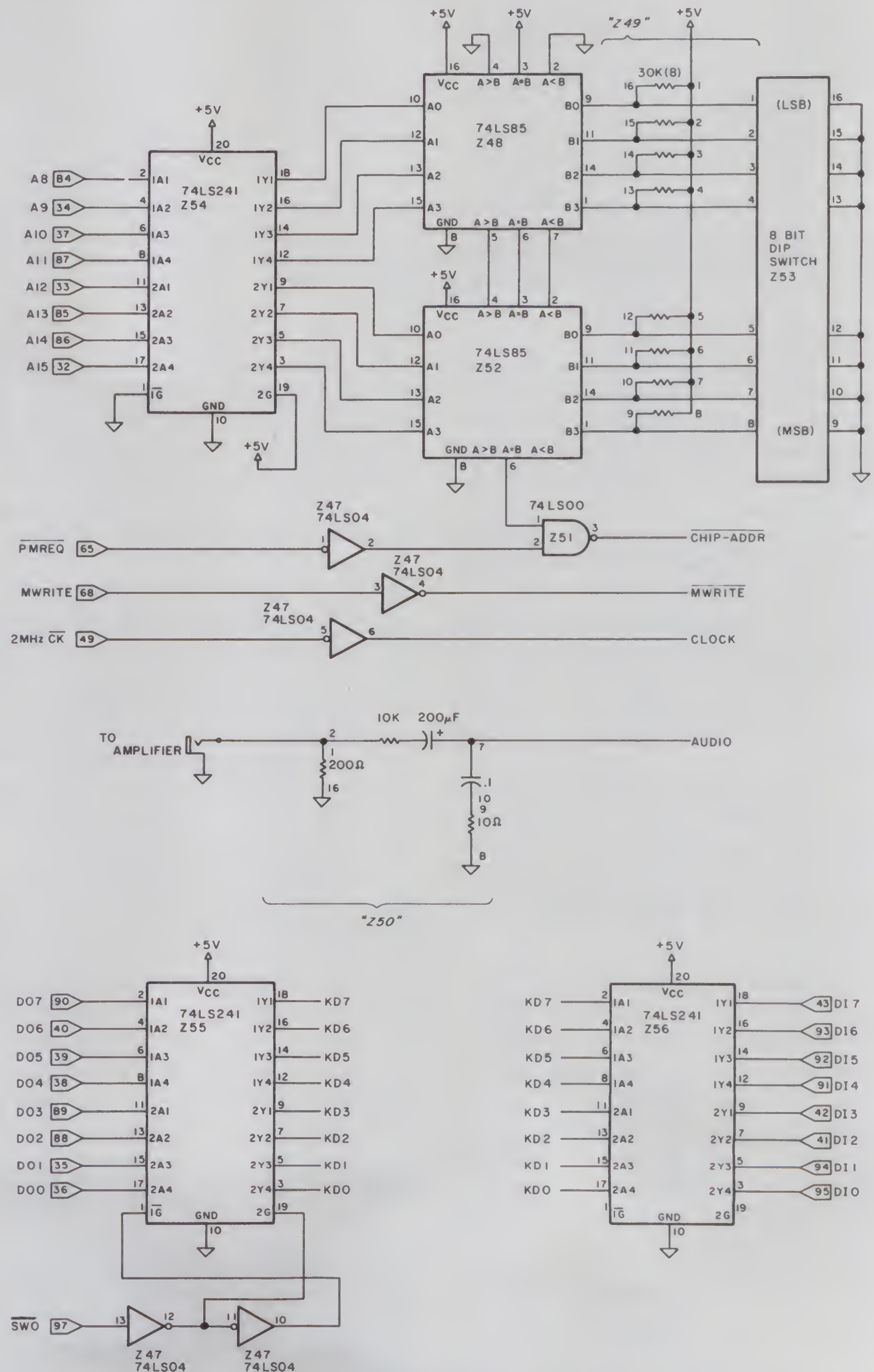



*Fig. 2. Main portion of the interface used to connect the SN76489 to an S-100 bus computer. Owners of different bus machines can come up with interfaces to their computers with just a few changes to the write line and chip select logic.*

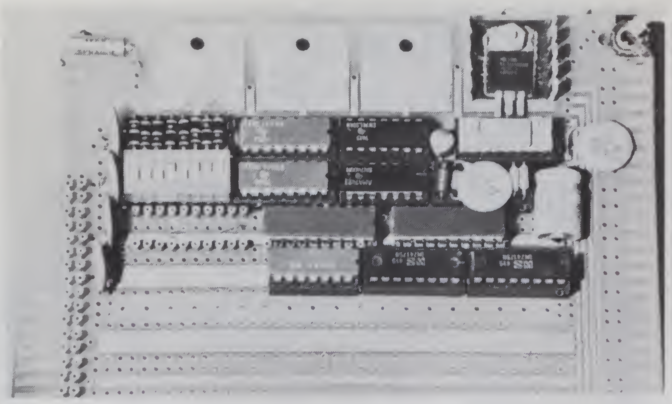


*Photo 2. A close-up of the section of the kludge board containing the circuitry. The audio output connection is the miniature phone jack in the upper right corner of the board. The SN76489 is the white ceramic IC directly below the TO-220 voltage regulator.*

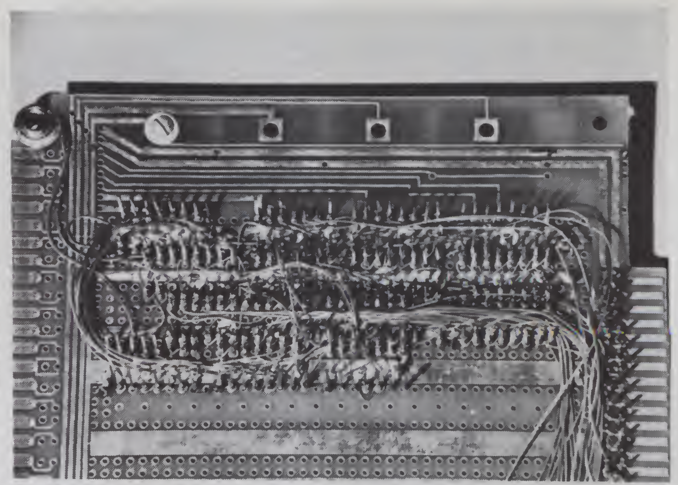


*Photo 3. Close-up of the wiring side of the kludge board.*

input. In the SN76494, three flip-flops have been deleted from the clock countdown chain. This means the maximum clock frequency is 500 kHz rather than 4 MHz. It also takes only two clocks to load data. The SN76494 is a better choice in systems that do not have a clock signal in the 2 MHz to 4 MHz range readily available.

### Hardware Requirements

Now that I've introduced you to the SN76489A, I'll cover the requirements to attach it to a computer.

The schematics of Figs. 2 and 3 show the circuitry I have used to interface a North Star Horizon to the SN76489A. I'll explain the purpose of each section of the circuit; depending on your processor, you may or may not need various parts.

The photographs show the actual hardware constructed to implement this music system. Photo 1 is the entire kludge board; you can see that there is plenty of room for future expansion. Photo 2 is a close-up of the circuitry huddled on the left edge of the board. Notice that the discrete components are plugged into IC sockets. This is neater than soldering the discretes directly into the circuit, and they can all be wire-wrapped. The less soldering the better.

The wiring side of the board is shown in Photo 3, but I don't know if you can get much from that jumble of wires. You're welcome to check the hookup if you want to.

The address decoder, composed of Z48, Z49, Z52 and Z53, is a good place to begin explaining. I used the eight-bit DIP switch to select the range of memory addresses that enable the SN76489A. Two four-bit magnitude comparators compare the eight most significant bits of the address bus with the number set in the DIP switch; the A = B output of Z52 goes high if they match. Since I ignored the eight least significant bits of the address, I used up a block of addresses 256 long. Those of you who don't want to give up that much of your address space can add two more 74LS85s and another DIP switch.

I used Z57, Z58 and Z59 to latch the data from the computer and hold it until the SN76489A accepts it. In an 8080 system you don't need this portion. If your processor does not have provisions for slow memory, you'll need these latches. Even if it does, you may still require them.

At first I left them out, since the Z-80 has a wait pin. However, in my system the PRDY line of the bus must be pulled low 125 nanoseconds after $\overline{\text{PMREQ}}$ goes low. Since the typical delay from chip enable to ready in the SN76489A is 100 nanoseconds, I was losing the race.

When this happens, the processor thinks the data have been accepted and continues on its way, while the SN76489A sits there thinking it saw some data go by. After adding the latches, the only consideration is that you must wait for the one-shot to time out before sending another byte of data.

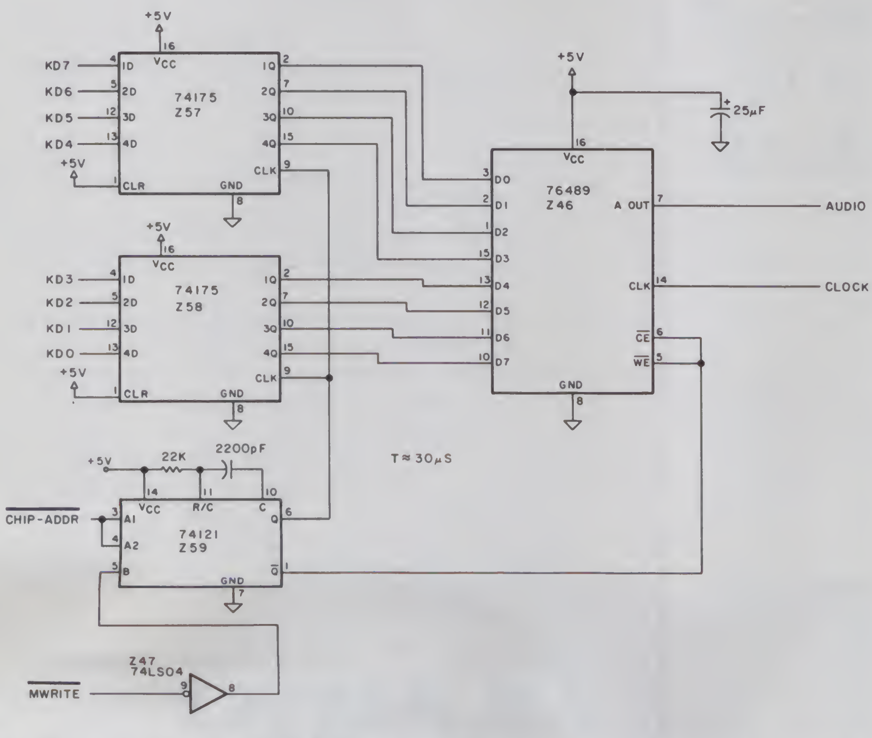



*Fig. 3. If your computer does not allow wait states, you can use this circuit between Fig. 2 and the SN76489. A pair of 4-bit latches are used to hold the data while the one-shot stretches the chip select pulse out long enough that the SN76489 is guaranteed to have accepted the data. The driving program must take this into consideration and refrain from sending data any faster than the one-shot takes to time out.*

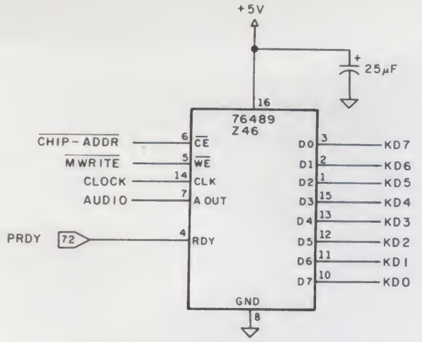



*Fig. 4. Those of you who can use wait states in your machine just need this circuitry plus that shown in Fig. 2. The open collector output of the SN76489 on pin 4 is used to halt the processor until the data has been latched on chip. In this case, the controlling program can ignore the time required to load the data into the SN76489 since it won't know any time has passed at all.*

This isn't a problem, since it takes close to 30 microseconds to look up the next byte anyway.

The net result of all this is those of you who need the latches should use Figs. 2 and 3; those who prefer to leave off the latches can use Figs. 2 and 4.

Z47 and Z51 are the glue gates that are used mostly for buffering the S-100 bus signals coming onto the board. One section of the NAND gate is used to combine the output of the address decoder and the PMREQ signal from the bus.

Z50 is a collection of passive components coupling the audio output of the SN76489A to the miniature phone jack. The .1 uF capacitor in series with 10 ohms stabilizes the on-chip amplifier; without these two components it tends to oscillate at about 20 MHz.

The 200 uF capacitor blocks the dc on the output of the SN76489A, and the 10k and 200 ohm resistors form the 34 dB pad.

Finally, Z54, Z55 and Z56 buffer the S-100 data and address lines. Z56 is obviously not needed, since no outputs from this circuit go back to the processor. In fact, I don't even have Z56 plugged in. If I did, I'd have to do something with the gating pins.

These three ICs are there because 80 percent of the kludge board I used is still empty. Someday I may want to add other circuits on the same board. If I do, I already have the buffers required. If you won't be putting any other circuit on the same board as the music generator, feel free to leave these three ICs out. Just jumper from input to output.

Before your brain gets too warped contemplating the data input lines to the SN76489A, I should point out that D0 designates the most significant bit; most



✓ Reader Service—see page 257

UPDATE FREQUENCY (2 BYTE TRANSFER)

| | REG ADDR | | | DATA | | | |
|---|---|---|---|---|---|---|---|
| 1 | R0 | R1 | R2 | F6 | F7 | F8 | F9 |

BIT 0 FIRST BYTE BIT 7

| | DATA | | | | | | |
|---|---|---|---|---|---|---|---|
| 0 | X1 | F0 | F1 | F2 | F3 | F4 | F5 |

BIT 0 SECOND BYTE BIT 7

UPDATE NOISE SOURCE (SINGLE BYTE TRANSFER)

| | REG ADDR | | | | | SHIFT | |
|---|---|---|---|---|---|---|---|
| 1 | R0 | R1 | R2 | X | FB | NF0 | NF1 |

BIT 0 BIT 7

UPDATE ATTENUATOR (SINGLE BYTE TRANSFER)

| | REG ADDR | | | DATA | | | |
|---|---|---|---|---|---|---|---|
| 1 | R0 | R1 | R2 | A0 | A1 | A2 | A3 |

BIT 0 BIT 7

*Fig. 5. Three types of data words used to send to the SN76489.*

microprocessors use D0 to represent the least significant bit.

**Data Formats**

Fig. 5 shows the three data formats used in programming the SN76489A.

Since the SN76489A only looks like a single memory location, the address of the internal register to receive the data must be included in the eight bits. The left-hand column in Fig. 5 shows the three-bit register address field. The eight registers on the chip are listed in Table 1.

The programmable counter on the chip is ten bits long, so it obviously takes more than one byte to change this value. Changing a frequency register requires a two-byte transfer. In order to tell the two bytes apart, the most significant bit (D0) is used as a flag. If it is a 1, the SN76489A interprets the byte as the first byte of the transfer; if it is a 0, the SN76489A assumes it is the second byte.

The first byte conveys the register address and four bits of data. If a byte arrives and a 1 is the most significant bit, the register address is latched in the SN76489A. The second byte, which does not contain a register address, is transferred to the register addressed by the on-chip latches. This allows the second byte to contain the remaining six bits of data necessary to provide a ten-bit number. The first byte contains the four least significant bits, and the second has the six most significant bits.

| R0 | R1 | R2 | Destination Control Register |
|---|---|---|---|
| 0 | 0 | 0 | Tone 1 frequency |
| 0 | 0 | 1 | Tone 1 attenuation |
| 0 | 1 | 0 | Tone 2 frequency |
| 0 | 1 | 1 | Tone 2 attenuation |
| 1 | 0 | 0 | Tone 3 frequency |
| 1 | 0 | 1 | Tone 3 attenuation |
| 1 | 1 | 0 | Noise control |
| 1 | 1 | 1 | Noise attenuation |

*Table 1. The three bits in the register address field of the data bytes determine which register on the SN76489A receives the rest of the bits as data. Addresses for the eight registers are shown here.*

| Bit Position A0 | A1 | A2 | A3 | Weight |
|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 2 dB |
| 0 | 0 | 1 | 0 | 4 dB |
| 0 | 1 | 0 | 0 | 8 dB |
| 1 | 0 | 0 | 0 | 16 dB |
| 1 | 1 | 1 | 1 | OFF |

*Table 2. The weights of the attenuation control bits. Multiple bits may be high simultaneously, allowing any volume from fully on to −28 dB to be selected for each sound source.*

Changing an attenuator setting requires only a single byte of data. Table 2 shows the weights of the four data bits. They have a binary weighting, with each count worth 2 dB of attenuation. The maximum attenuation available that still has sound coming out is 28 dB, which is A0, A1 and A2 equal to 1 and A3 equal to 0. If all four bits are 1, the signal source for that particular attenuator is gated off and no sound is produced. This removes any unused tone or noise generators from the picture.

Updating the noise source involves changing two short registers on the chip. The first is the FB register, as shown in Table 3. This bit controls the feedback to the 15-bit shift register used to produce the noise. If you set the FB bit, you use the exclusive OR feedback network, which results in white noise. If you reset this bit, the feedback network to the shift register is disabled and a rectangular pulse with a 1/15 duty cycle is produced.

The two bits in the shift rate register (Table 4) control the clock to the 15-bit shift register. N represents the input clock frequency on pin 14. In addition to the three


Xymec
HY-Q 1000
VALUE STANDARD ◀117T

```
10 REM  THIS PROGRAM TESTS THE 76489 SOUND CHIP
70 INPUT A$
80 REM  TONE GENERATOR TEST
90 N=59392
100 FILL N,144
110 FILL N,191
120 FILL N,223
130 FILL N,255
140 FILL N,128
150 GOSUB 1000
160 FILL N,159
170 FILL N,176
180 FILL N,160
190 GOSUB 1000
200 FILL N,191
210 FILL N,208
220 FILL N,192
230 GOSUB 1000
240 FILL N,223
250 FILL N,240
260 FILL N,224
270 GOSUB 900
280 FILL N,225
290 GOSUB 900
300 FILL N,226
310 GOSUB 900
320 FILL N,227
330 GOSUB 900
340 FILL N,228
350 GOSUB 900
360 FILL N,229
370 GOSUB 900
380 FILL N,30
390 GOSUB 900
400 FILL N,231
410 GOSUB 900
420 FILL N,255
430 REM  ATTENUATOR TEST
440 FOR J=1 TO 1000\NEXT J
450 FILL N,128
460 FILL N,8
470 O=144
480 GOSUB 1200
490 FILL N,160
500 FILL N,8
510 O=176
520 GOSUB 1200
530 FILL N,192
540 FILL N,8
550 O=208
560 GOSUB 1200
570 FILL N,228
580 O=240
590 GOSUB 1200
600 GOTO 70
610 END
900 FOR J=1 TO 500\NEXT J
910 RETURN
1000 FOR I=63 TO 0 STEP -1
1010 FILL N,I
1020 FOR J=1 TO 20\NEXT J
1030 NEXT I
1040 RETURN
1200 FOR I=0 TO 15
1210 FILL N,O+I
1220 FOR J=1 TO 40\NEXT J
1230 NEXT I
1240 RETURN
```

*Listing 1. A BASIC program that demonstrates the sound board and can be used as a test that it is functioning properly.*

fixed rates, you can select the output from tone generator 3 as the shift clock. In this way, you can produce interesting sounds such as swept frequency noise by ramping the frequency of tone generator 3.

I've now covered the hardware for a three-voice music board and the basics of programming the SN76489A to produce the sounds you want. From here on, it's all software.

| FB | Configuration |
|---|---|
| 0 | Periodic noise |
| 1 | White noise |

*Table 3. The FB bit in SN76489 register 6 controls the type of noise produced by the noise generator.*

| Bits NF0 | Bits NF1 | Shift Rate |
|---|---|---|
| 0 | 0 | N/512 |
| 0 | 1 | N/1024 |
| 1 | 0 | N/2048 |
| 1 | 1 | Tone generator 3 output |

*Table 4. The NF bits in register 6 control the rate at which the noise generator is clocked and thus the audible characteristics of the noise.*

### Locating the Board in Memory

If you're like me, the first thing you want to know after constructing the board is: Does it work? You can test it by using a monitor or BASIC to send data bytes to the board.

Before this, you must decide where in memory you will locate the board and set the DIP switch accordingly. In all my example programs, the music board address is E800 hex, or 59392 decimal. This is an ideal place, in a North Star disk system, since this 256-byte block of memory is used for the disk ROM. Because the music board looks like a WOM (write only memory), there is no conflict.

### The Test Program

Rather than check out the circuit manually, you can use the program in Listing 1. Although there are quite a few lines, the coding is easy to follow. Each tone generator on the SN76489A is individually turned on and ramped from a low to a high frequency. You then put the noise source through its paces. Finally, you ramp each attenuator from full volume to minimum volume and off.

```
1 REM  2-28-79  THIS PROGRAM PLAYS MUSIC USING A KLUDGEHARP
2 REM           APPROACH ON THE SN76489
5 N=59392
6 REM TURN OFF EVERYTHING
7 FILL N,159\FILL N,191\FILL N,223\FILL N,255
10 DATA 213,16,213,8,142,8,159,8,142,8,190,16,179,4,190,8
20 DATA 213,24,142,16,119,8,106,2,119,2,106,12,119,4,142,8,127,8
30 DATA 159,8,142,16,142,8,106,16,213,8,179,16,159,8,142,8,159,8
40 DATA 179,8,213,4,239,16,213,16,142,8,159,16,179,8,190,8
50 DATA 213,8,239,8,213,8,0,0
200 DIM F(100),T(100)
210 FOR I=1 TO 100
220 READ F(I),T(I)
230 IF F(I)=0 THEN EXIT 500
240 NEXT I
250 PRINT "SONG TOO LONG."
260 END
500 I=1
510 B=INT(F(I)/16)
520 A=F(I)-B*16+128
530 FILL N,A
540 FILL N,B
550 FILL N,144
560 FOR J=1 TO 35*T(I)
570 NEXT J
580 FILL N,159
590 I=I+1
600 IF F(I)=0 THEN 1000
610 GOTO 510
1000 END
```

*Listing 2. A BASIC program that plays a portion of "Scarborough Fair" using the music board. Only a single tone generator is used.*

Line 70 simply waits for a carriage return before beginning the test. Line 90 sets the address of the music board; change this if your board is addressed elsewhere. Lines 100–240 exercise the three tone generators.

First, attenuator 1 is turned on, and the others are turned off. Tone 1 is initialized, and the subroutine at 1000 ramps the frequency. After tone 1 has been ramped, attenuator 1 is turned off and attenuator 2 is turned on. Tone 2 is demonstrated; in a similar manner tone 3 is used. You can verify this by taking the numbers being poked to memory (the Fill commands), converting them to binary and comparing them with the formats in Fig. 5.

Lines 250–420 set up each type of noise and jump to a subroutine at 900 to delay a while so you can hear the results.

Lines 430–590 demonstrate the four attenuators. Before an attenuator is turned on, its tone generator is set to mid-frequency. The subroutine at 1200 produces the ramp, turning the attenuator to full volume and then, with a slight delay between steps, ramping it down to zero volume.

When you run this program, you'll hear the types of sounds the SN76489A is capable of producing. Notice that ramping the volume of a tone generator produces a bell-like sound. The attack, sustain and decay times of a tone have quite an effect on the end result. A music program that made full use of the attenuators could play music on three different instruments simultaneously.

The first time you successfully run the test program, the results sound pretty good, but the effect rapidly wears off. Music is what this board was intended for; let's see what we can come up with in a short program.

### A Music Program

One reasonably easy approach is to start with two tables of numbers. The first contains the ten-bit numbers to be loaded into a tone generator; the second table contains numbers representing the length of time each of the ten-bit numbers should be sounded. The program in Listing 2 uses this approach to play part of "Scarborough Fair."

After initializing the pointer to the music board, all four attenuators are turned off to silence unwanted noise. Lines 10–260 read the numbers into the F (frequency) array and the T (time) array. Lines 500–610 play the song. Remember—since the F values are sent directly to the music board, they are really the period of the desired square wave.

As each frequency value is used, it is broken into two parts: the four least significant bits and the six most significant bits. The value is then sent to the music board using two Fill commands. Now that the frequency is loaded, the attenuator is set to full volume, and a FOR loop delays the amount of time specified by the T value. When the time is up, the attenuator is



✓Reader Service—see page 257

```
1 REM  2-28-79  THIS PROGRAM PLAYS MUSIC USING A KLUDGEHARP
2 REM           APPROACH ON THE SN76489
5 N=59392
10 DATA 213,16,213,8,142,8,159,8,142,8,190,16,179,4,190,8
20 DATA 213,24,142,16,119,8,106,2,119,2,106,12,119,4,142,8,127,8
30 DATA 159,8,142,16,142,8,106,16,213,8,179,16,159,8,142,8,159,8
40 DATA 179,8,213,4,239,16,213,16,142,8,159,16,179,8,190,8
50 DATA 213,8,239,8,213,8,0,0
200 DIM F(100),T(100)
210 FOR I=1 TO 100
220 READ F(I),T(I)
230 IF F(I)=0 THEN EXIT 500
240 NEXT I
250 PRINT "SONG TOO LONG."
260 END
500 I=1
510 B=INT(F(I)/32)
520 A=F(I)/2-B*16+128
530 FILL N,A
540 FILL N,B
542 B=INT(F(I)/16)
543 A=F(I)-B*16+160
544 FILL N,A
545 FILL N,B
550 FILL N,144
551 FILL N,176
560 FOR J=1 TO 35*T(I)
570 NEXT J
580 FILL N,159
581 FILL N,191
590 I=I+1
600 IF F(I)=0 THEN 1000
610 GOTO 510
1000 END
```

*Listing 3. The program in Listing 2 modified to use two of the three tone generators on the music board. The second generator is set an octave higher than the first.*

turned off and the next pair of array values are used to specify the next note.

Running this program demonstrates the problem of trying to control the music board from a BASIC program: BASIC is just too slow. The period of time that the attenuator is off is noticeable, and the music sounds jerky.

You may ask why you can't leave the sound on. If you have constructed the board, you can try this by deleting statement 580. Unfortunately, this sounds worse. The ten-bit number must be loaded using two distinct Fill commands. Even though they are on consecutive lines, there is a slight delay between them. During this time, the ten-bit counter is loaded with six bits of old data and four bits of new data, which does not represent a frequency you want. As the notes change, extraneous clicks and squeaks are produced.

The program in Listing 3 is the same as Listing 2, except a pair of tone generators is used. The second frequency is simply set an octave higher than the first. Although the pauses between notes are still there, the notes are more interesting.

Next month I'll detail a combination assembler and BASIC program that solves the speed problem by combining the strong points of both machine language and BASIC. ■

Reader Service—see page 257

# APF Imagination Machine —A Review

*The Imagination Machine may look like a single unit, but it actually consists of two parts, which sit on top of each other and are joined by a rigid connector. The MP1000 microprocessor unit (top left) contains the central portion of the computer. The MPA-10 base unit contains more RAM memory, the alphanumeric keyboard, cassette deck and expansion circuitry.*

*Peter A. Stark*
*PO Box 209*
*Mt. Kisco, NY 10549*

Since the 6800 is my favorite microprocessor, the ads for the Imagination Machine from APF Electronics, Inc. (which uses the 6800), immediately caught my eye. I couldn't wait to get my hands on one and try it. It turned out to be a very interesting system.

The Imagination Machine is a self-contained, desktop computer with a full alphanumeric keyboard, two separate game paddles with their own calculator-style keyboards and a built-in cassette deck. It connects to the antenna terminals of a color TV set, which provides full-color graphics as well as a 16-line by 32-character alphanumeric display. In addition, the Imagination Machine provides an audio output via the TV set's speaker.

It can be programmed in either BASIC or machine language, and programs can be entered from the keyboard, disks or cassettes or via plug-in ROM cartridges. A variety of game, home finance and utility cassettes and cartridges is available from APF dealers.

The basic Imagination Machine (which APF now calls the System I) costs $599 with cassette I/O; the System II version at $995 adds the $100 expansion interface, $150 disk interface and $400 minifloppy disk drive and provides a disk system at an even better price.

Though the Imagination Machine can be operated with just the supplied programs, there is enough to make a review of it from a more technical standpoint worthwhile.

### The Hardware

Although photographs show the Imagination Machine as a single unit, it actually consists of two parts, which sit on top of each other. One unit—the smaller, black assembly at the top left—is the MP1000 microprocessor unit, which contains the central portion of the computer. The other—which is the larger, gray assembly at the bottom—is the MPA-10 base unit. It contains more RAM memory, the alphanumeric keyboard, cassette deck and expansion circuitry.

These two units are joined by a rigid metal bracket and connector assembly so that they cannot be moved apart. Each unit has its own power supply with an external power transformer, which plugs into a wall outlet.

To expand the System I machine, APF offers the BB-1 building block. This unit plugs into the back of the MPA-10 and, in turn, provides four additional plug-in slots. At this point, APF makes three modules that fit these slots—an 8K RAM cartridge, an RS-

232C serial interface and a minifloppy disk interface.

### The MP1000 Microprocessor Unit

The MP1000 is actually a self-contained TV game (and was first introduced as just that). Except for the lack of general-purpose I/O equipment, it is a complete computer all by itself (I suspect that it would make an excellent—and inexpensive—color video board if interfaced to, say, an SWTP 6800 system). Like most TV games, this one has a pair of paddle controllers (which include a complete calculator-style keyboard as well) and a slot for plug-in game cartridges. Its 6800 microprocessor is not only a very powerful processor (not nearly well enough known, in my opinion), but is also an extremely simple one to learn and use.

A 6847 video display generator chip generates the color graphics and/or an alphanumeric display. In this system, the 6847 provides two graphics modes—low-resolution graphics with alphanumerics or high-resolution graphics without alphanumerics.

In low-resolution mode, the screen is divided into 16 lines by 32 characters. Each of the resulting 512 character positions can contain either an alphanumeric character —in several different color combinations —or can be further divided into four smaller boxes, each of which can be turned on or off.

In high-resolution graphics, the screen can provide either 128 by 192 or 256 by 192 graphics. In this mode, the screen is divided into 32 boxes across by 12 boxes down. Each of these 384 boxes can contain a specific pattern, which can consist of either 4 × 16 dots or 8 × 16 dots each. Each of these patterns is stored in a separate area of RAM, so that it can be moved from place to place on the screen without having to be redefined each time. This allows fast screen movement and is especially useful for preprogrammed games.

An MC1372 color video modulator provides an rf signal on TV channel 3. This is coupled to the TV set's antenna terminals through an FCC-approved antenna switch, so that the set can be used for either regular TV reception or computer use by just throwing the switch.

The data being displayed is held in a 1K RAM. In the low-resolution/alphanumeric mode, only 1/2K is used to hold the ASCII or graphics codes being displayed; then the other 1/2K can be used to construct another image to be rapidly swapped into the usable 1/2K (or stored on cassette).

In high-resolution graphics, the first 1/2K specifies which pattern is in each screen position, while the second 1/2K specifies the shape of each pattern.

All of this is done under control of a 2K ROM, which is pin compatible with the popular 2716, and which contains a variety of housekeeping and graphics routines, plus a game called Rocket Patrol.

The two joystick controllers are connected to the data pins of a PIA parallel interface chip, and software scans their joystick and calculator-style keys. The joystick uses four switches, rather than pots, for the four directions, and so does not provide a proportional readout.

At the back of the MP1000 is a 30-pin socket for either game cartridges or the connector, which attaches the MP1000 to the base assembly of the Imagination Machine. The connector has all of the bus signals, including the full data bus, address bus, Read/Write and +5 volts.

(For interested owners, APF publishes a complete technical manual for $2 which provides all of the diagrams and technical information on what's in the Imagination Machine and how it works. This distinguishes APF from many other computer manufacturers—not only do they offer the technical manual, but also each accessory manual contains a full schematic diagram, and even program listings of their BASIC interpreter are available at a nominal charge. Unlike some other manufacturers who hold back information which a purchaser could find useful, APF hides nothing.)

### MP1000 Software

The Rocket Patrol game contained within the MP1000 game's internal ROM is not particularly exciting. But APF has available about a dozen plug-in ROM cartridges (mostly $19.95 each) containing a wide variety of games, including Catena, Hangman, Tic Tac Toe, Doodle, Bowling, Micro Match, Brickdown, Shooting Gallery, Baseball, Blackjack, Backgammon, Roulette, Keno, Slots, UFO, Sea Monsters, Break It Down, Rebuild, Shoot, Pinball, Dungeon Hunt, Blockout and Boxing.

Some cartridges contain just one game; some contain two or three. Some games are for one player; some are for two or four. Several game cartridges, such as Baseball, have excellent color graphics.

### The MPA-10 Base Unit

When you put the MP1000 game on top of the MPA-10 base unit and connect them together, you have the complete Imagination Machine.

The MPA-10 adds RAM and I/O capabilities to the processor inside the MP1000 and makes it into a full-fledged computer.

Inside the base unit is 8K of RAM, which uses eight 4115 8K × 1 dynamic RAMs; these are similar to the 16K × 1 4116-style dynamic RAMs used in the TRS-80, Apple and other popular computers. (In fact, with fairly minor changes, the 4115 could be replaced by 4116 ICs, and the memory expanded from 8K of RAM to 16K; though this would add 8K of memory for perhaps $30–$50, it would also require some wiring changes and probably void the warranty as well. In the long run, it is easier to buy the 8K expansion cartridge from APF for $99.95).

A PIA inside the MPA-10 provides a number of I/O functions. Eleven of its parallel I/O pins are connected to a full 53-key keyboard, which is scanned by software. The keyboard has a good feel to it, and is easy to use even for long periods. Software scanning of the keyboard is not an optimal approach—it takes up too much CPU time—but it is an inexpensive method which is also used on the TRS-80 and other computers, an alternative to a separate keyboard scanning controller such as the 2376 used in more expensive systems.

The only disadvantage here is that a properly interfaced separate keyboard scanner will store a keyboard character even after the key is released; thus, the character will be entered even if the computer wasn't actually looking for it at the time you press the key. In the software approach, on the other hand, there are times when you must depress a key for a half second or more when a BASIC program is executing and not looking for input just then.

Next to the keyboard is a built-in cassette recorder which has an interesting function. It is a two-track deck, with one track used for digital data and the other for audio. Both the audio and digital tracks, as well as the motor during recording or playback, are controlled by the computer *via the keyboard* PIA.

This makes for some interesting possibilities. For instance, APF program cassettes contain the program on one track and an announcer's voice on the other. As the cassette is being loaded, you hear the announcer describe the program and how to use it. It takes about 45 seconds to load a full 8K program (at an effective rate of about 1500 baud), and this certainly makes the time pass quickly.

Since the audio and motor can be computer controlled, this machine could easily be used for educational purposes where the computer could play selected lessons or musical selections under program control, skip ahead or even chain to additional program segments. Either or both tracks can be recorded on the Imagination Machine itself, so you can experiment with this concept yourself.

Although the cassette deck could be used for any purpose, given the right program, the BASIC software has a specific method of recording or loading cassette data. When recording a cassette, it first records the screen memory in the MP1000 game unit, followed by the complete 8K (or

16K) memory of the MPA-10 base unit. When playing back, it first reads the screen memory and displays it, followed by the 8K of program storage. Thus, you can set up a picture on the screen to be recorded to tape; when the tape is then loaded, the screen will automatically show that picture, and the audio track can simultaneously provide music or narration while the program is being read. APF makes full use of this in their program cassettes, and it is a very pleasing effect.

On the back of the MPA-10 are three connectors—two 30-pin connectors just like that on the MP1000 game, and a 50-pin connector with some additional signals for the expansion box.

One of the 30-pin connectors is used to join the MPA-10 base unit to the MP1000 game unit. This is done with a rigid J-shaped bracket that contains a flexible printed-circuit board, which contains bus drivers and bidirectional transceivers.

The second 30-pin connector is used for ROM cartridges. The same game cartridges that fit the MP1000 alone can also be plugged into the 30-pin connector on the MPA-10 base unit, so that the full Imagination Machine can run these games as well. In addition, the base unit comes with a 12K BASIC cartridge, which allows programming in that popular language.

Finally, the 50-pin connector is for the external building block expansion box.

### Building Block Expansion

Once you add the expansion box (at about $100), you can plug in an 8K RAM cartridge ($99.95), an RS-232C interface cartridge (also $99.95) or floppy disk interface ($149.95) with either the APF minifloppy drive ($399.95 with cabinet and power supply) or any other Shugart-compatible 5-¼ inch drive.

The 8K RAM cartridge is equipped with a switch to enable or disable this extra RAM as desired. This is useful, since the cassette storage always writes the contents of the entire RAM space on tape. 8K of memory will therefore save and load faster than 16K. Since the BASIC and disk operating system are in ROM, and since BASIC source programs are stored in a compressed form, 8K of RAM will hold fairly sizable programs, and so the RAM expansion can be disabled for most programs.

The EIA RS-232C serial port cartridge contains a tiny switch for selecting baud rates between 110 and 9600 baud. It has the standard 25-pin plug and provides for modem handshaking.

Selection of the serial port is made by a form of the PRINT statement. PRINT = 1 routes all succeeding output to the serial port instead of the TV screen. PRINT = 2 outputs to the serial port and also accepts all input from the port; in this mode the computer can be fully operated from a remote terminal or, with a modem, via a telephone line (though not with graphics).

The Imagination Machine can also be used as a terminal to a remote computer; the machine-language program to achieve this is provided in the serial port's instruction manual.

The floppy disk interface supports one or two disk drives. The disk operating system is inside the BASIC ROM cartridge, so that no extra disk space is required for the operating system.

Each diskette provides 72K bytes of storage and has room for up to 16 files, each with a seven-character file name. A disk can store BASIC programs, sequential files or random files.

### APF BASIC

Supplied with the MPA-10 base unit is a ROM cartridge which contains APF Level I BASIC. This cartridge contains a 4K ROM and an 8K ROM, for a total of 12K; but not all of that is used for BASIC itself. Also included is the disk operating system, as well as routines for scanning the keyboard and for cassette I/O. It also has a small monitor for directly entering or displaying machine-lan-

guage programs or data in memory. Using this monitor, it is possible to enter machine-language programs or to add machine-language subroutines to BASIC programs for faster execution speed.

In a way, APF BASIC show the disadvantages of having a BASIC in ROM. If it were in RAM, it could be expanded, patched or changed; but in ROM it's fixed and unchangeable. (Though a ROM cartridge is somewhat easier to change than having a permanent ROM a la the TRS-80 or PET. A new Level II BASIC cartridge should be available by the end of 1980.)

APF Level I BASIC is about midway between an integer BASIC and a floating-point BASIC. All numbers are carried as 13 decimal (BCD) digits, with nine to the left and four to the right of the decimal point. This is perfect for money calculations up to $999,999,999.9999, as well as most general-purpose calculations, but would not be suitable for scientific calculations.

Since calculations are done in BCD, there is no round-off error; you needn't worry that the cents will be wrong in a large financial calculation, as they might be in a binary floating-point computer.

In keeping with the unscientific nature of the machine, there is a minimum of arithmetic functions—just ABS, INT, RND and SGN (RND is not very good, since it returns only two-digit numbers from 0.01 to 0.99). There is no SIN, COS or SQR, which makes some games difficult to program. There is only an integer exponentiation, so that calculations involving noninteger powers also are difficult. In fact, a prerecorded APF cassette program which calculates loan interests takes ages to compute compound interest—and finally gives the wrong answer—because of this lack.

String variables can contain up to 100 characters, which should be long enough for almost any purpose. The HP string convention—wherein every string must first be dimensioned for its maximum string length—is used. This makes it possible to save space by defining each string a different length, but makes programming nonstandard.

For example, the statement DIM A$(20) dimensions not an array, but a single string A$ with 21 characters. The subscripts start with 0, so dimensioning at 20 actually means 21 characters; but it is not possible to dimension a string of length 1 with DIM A$(0).

One-dimensional string arrays are dimensioned as DIM A$(5,10), which means that there are six strings of 11 characters each. There are no two-dimensional string arrays (though there are such numeric arrays).

There are very few string functions—only ASC, CHR$ and LEN. Since strings are dimensioned as arrays, it is possible to get characters in a string by using the subscripts. For example, if A$ is dimensioned as ten characters such that A$ = "ABCDEFGHIJ," then A$(4) would be everything to the right of the fourth character. By juggling subscripts and using the LEN, ASC and CHR$ functions, it is possible to simulate the more traditional LEFT$, MID$ and RIGHT$ functions, but it's not easy.

An input to a string is somewhat unusual in that it does not erase a string prior to inputting into it. Thus, the string may contain

# More on APF's Graphics

| | C1 | C2 | C3 | C4 |
|---|---|---|---|---|
| R0 | | | | |
| R1 | | | | |
| R2 | | | | |
| R3 | | | | |
| R4 | | | | |
| R5 | | | | |
| R6 | | | | |
| R7 | | | | |
| R8 | | | | |
| R9 | | | | |
| R10 | | | | |
| R11 | | | | |
| R12 | | | | |
| R13 | | | | |
| R14 | | | | |
| R15 | | | | |

*Table 1. High-Resolution Character.*

*Richard Esposito*
*Bertram Thiel*
*62 Meadow Rd.*
*Frostburg, MD 21532*

The manual that accompanies the IM-1 is written for the person already familiar with BASIC and with the inner workings of data storage in a microcomputer. When the high-resolution mode is entered with the program statement

POKE 8194,158 : POKE 8193,60

the RAM used for screen characters becomes RAM used for defining the fine graphics characters (see Table 1) that are numbered 0 through 31.

Line 1 of the screen memory defines characters 0 and 1, line 2 for characters 2 and 3, line 3 for characters 4 and 5, and so on. The first 16 bytes of each line are for even characters, and the second 16 are for odd characters.

Memory position 512 is row 0 of character 0; position 513 is row 1 of character 0; and so forth to address 527. Memory position 528 is row 0 of character 1, position 529 is row 1 of character 1, and so on.

Reread the previous paragraphs again and visualize the screen as a map of RAM from position 512 to 1023. To define all characters you will have to poke all of these positions. This is a formidable task at first, but bear with us; it will get a little worse before the fog lifts.

Now for the final hurdle. By now, you should be asking yourself: "Just what number do I poke into these memory locations?" The answer is, "Why, the decimal equivalent of a coded-base 4 number!" We'll bet you thought you had it made once you mastered bases 2, 8 and 16. This one is easy. Each of four colors has an equivalent number that defines it: green = 0, yellow = 1, blue = 2 and red = 3. Just determine

not only the new string, but also parts of the old string. Remembering to always set the string to a null string before an input solves the problem, but it means that programs running on other systems require some translation before they will run in APF BASIC.

In other ways, APF BASIC is convenient. Variable names can be up to five characters, though only the first two are used by the machine. A variety of statements is present, including GOTO, GOSUB, RETURN, ON GOTO, ON GOSUB, IF THEN, FOR-NEXT, END, STOP, REM, DATA, READ, RESTORE, INPUT, PRINT and even PRINT USING.

The keyboard (and display) have uppercase letters only. Although there is a CTRL key, it does not generate the traditional control characters. Instead, pressing CTRL and another key generates entire keywords. For instance, the CTRL-Y combination generates the word PRINT on the screen. To cut down on program storage, keywords are stored as single characters in memory, and the CTRL key lets them be entered that way directly from the keyboard.

To allow BASIC to sense whether a key is pressed—without waiting for a carriage return—BASIC's KEY$ statement allows the program to sense not only keys on the main keyboard, but also the calculator keys on the joysticks and the joystick paddles themselves.

Cassette program storage is controlled by CLOAD and CSAVE commands, which load or store all of RAM. There are no explicit commands for maintaining data files on cassettes, but since CSAVE saves all of RAM, it saves not only the program, but also all dimensioned variables. Hence a program and its data can be saved for later reuse. Once the cassette is CLOADed, the program can be run again; the only precaution is that it must be started with a GOTO rather than a RUN statement, since RUN automatically resets all variables to 0 before starting. Several APF financial programs (such as an excellent Checkbook/Budget Manager cassette) make use of this feature to build a data set month after month.

APF BASIC can access machine-language programs or data via PEEK, POKE and CALL statements. This allows BASIC to control I/O equipment such as the cassette recorder—a very necessary function since the BASIC interpreter forgets to turn off cassette audio after a cassette is loaded, and there is enough hum in the audio system to make it objectionable. It is also easy to link to machine-language subroutines; the technical reference manual describes this procedure extremely thoroughly. A serious programmer needs that manual, since the main BASIC instruction manual's 21 pages don't explain much of the system; it only makes sense to someone who already knows some BASIC. (A BASIC Tutor program cassette is available for $49.95 to teach BASIC to a beginner.)

APF BASIC has two extensions—one for graphics, the other to play tunes via the TV set's speaker.

Music is played by a MUSIC command. Each note of three octaves is assigned a number from 1 to 7 for the middle octave, /1 to /7 for the lower octave or *1 to *7 for the

---

which color you want in each of the four pixels of a line of a character and solve the formula

C1*64 + C2*16 + C3*4 + C4

and you end up with a decimal number that represents the four colors in the four columns of the row of that defined character.

Here's an example. The character we wish to define is number 5, whose memory location starts at 512 + 16*5, or 592. The row of that character is number 8, whose memory position is thus 592 + 8, or 600. The colors we want are red (3) in column 1, green (0) in columns 2 and 3 and yellow (1) in column 4. Using the formula, we get

3*64 + 0*16 + 0*4 + 1*1 = 193

Thus, we would use the statement POKE 600,193 to define those four pixels. Sixteen POKE statements define the whole character if each row was different from the others, as in defining a chess piece shape or a kata kana character.

However, many or all lines are often the same so that a character definition can be simplified with a FOR-NEXT loop. Thus,

```
FOR X = 592 TO 607
POKE X,193
NEXT X
```

will define character 5 as consisting of three vertical stripes—a thin red one, a thick green one and a thin yellow one.

**Applications**

When you are in high-resolution graphics mode, what is displayed on the screen is addressed by RAM memory from address 0000 to 383 (base 10). That's 32 characters across the screen and 12 down (as contrasted to 16 down in alphanumerics mode). All you have to do now is poke into that section of memory the appropriate defined character. Thus,

```
10 FOR X = 0 TO 371 STEP 12
20 POKE X,5
30 NEXT X
```

will place the character we created down the left edge of the video field.

If you think you now have a handle on the high-resolution graphics, study the program in Listing 1 and try it out. Note that here we define the special graphics *before* we enter the high-resolution mode, so that you will be able to watch them being defined by your program at the top of the TV screen just before entering the second part of the program that gives a random sprinkling of the characters over the field.

Then, while still in high-resolution mode, the KEY$(X) waits for a key to be depressed; when it is, it redefines character number 4 to solid yellow. A second KEY$(X) allows escape from the high-resolution mode with POKE 8193,52 : POKE 8194,30.

If you forget to escape the high-resolution mode with these two POKE statements when you are programming and you think you have lost control, don't hit the reset or break buttons. Hit break and carefully type in the two POKE statements (you won't see them on the screen, but they are in the computer). Then hit enter and you're back to the land of reality. ■

```
100  REM HI RES GRAPHICS DEMONSTRATION
110  REM ESPOSITO/THIEL DEC1979
120  REM CHAR#0 = VERT STRIPES
130  FOR I = 0 TO 15
140  POKE 512 + I, 198
150  NEXT I
160  REM CHAR#1 = SOLID GREEN
170  FOR I = 0 TO 15
180  POKE 528 + I,0
190  NEXT I
200  REM CHAR#2 = HORIZ STRIPES
210  FOR J = 0 TO 3
220  FOR I = J TO J + 12 STEP 4
230  POKE 544 + I, 85*J
240  NEXT I
250  NEXT J
260  REM CHAR#3 = SOLID RED
270  FOR I = 0 TO 15
280  POKE 560 + I,255
290  NEXT I
300  REM CHAR#4 = ZIG-ZAG
310  FOR J = 0 TO 3
320  FOR I = 0 TO 8 STEP 8
330  POKE I + J + 576,4↑J
340  POKE I + J + 580,4↑(3 - J)
350  NEXT I
360  NEXT J
370  REM SETUP FINE RES MEMORY
380  REM WITH GREEN CHAR#1
390  FOR I = 0 TO 383
400  POKE I,1
410  NEXT I
1000 REM ENTER HI RESOLUTION MODE
1010 POKE 8194,158 : POKE 8193,60
1020 REM RANDOM CHARACTER FIELD
1030 FOR I = 0 TO 383
1040 POKE I, INT(RND(0)*5)
1050 NEXT I
1060 IF KEY$(X) = "" THEN 1060
1070 REM RE-DEFINE CHAR#4 TO YELLOW
1080 FOR I = 576 TO 591
1090 POKE I,85
1100 NEXT I
1110 IF KEY$(X) = "" THEN 1110
1120 REM EXIT HI RESOLUTION MODE
1130 POKE 8193,52 : POKE 8194,30
```

*Listing 1.*

*APF's Imagination Machine features a typewriter keyboard, two game-style controllers, a built-in cassette deck, a built-in microphone jack, a cartridge connector plus the expansion box to add on a printer, telephone modem, minifloppy disk or additional memory.*

upper octave (with + or − signs for sharps and flats). Placing these symbols into a string variable or constant after the word MUSIC results in playing the indicated tune. Though the resulting monotonic music is quite plain, it does add an interesting touch to some programs. Individual tones are also used in many APF programs to provide keyboard feedback.

Low-resolution graphics are handled through five special commands. A COLOR command assigns one of eight colors to the current cursor position, while the SHAPE command can paint one of 16 shapes at that position. The cursor position is chosen by a PLOT command.

In addition, HLIN and VLIN commands can plot horizontal or vertical lines.

High-resolution graphics are also possible, but must be done through PEEKs and POKEs to the graphics RAM. It is possible to fully control this mode from BASIC, as well as PEEK into various locations to see what is on the screen, where the cursor is and so on. But APF BASIC is so slow that any such graphics would require overly long waits. To achieve reasonable graphics speeds, you really have to add machine-language routines or write everything in machine language. (Only one APF game cassette—Word Factory—is written in machine language; all the others are in BASIC and have very slow graphics movement.)

**Software**

The Imagination Machine can essentially run four kinds of programs—those available in a cartridge, those sold on disk or cassette and those you write yourself.

The cartridge programs are the same games (listed above) which are sold for the MP1000. All of these are written in machine language, and provide quite good graphics of the TV-game kind.

With one exception, APF cassette programs are written in BASIC. The exception is a game called Word Factory, which is a spelling game for children in the 6–9 age group. (But note that even here, the BASIC cartridge must be inserted to provide the CLOAD command needed to load the cassette.) Word Factory is interesting for kids, except that its vocabulary is necessarily limited. Since it is written in machine language and is not documented, even a customer with excellent programming ability would have trouble adding more words.

BASIC cassettes currently available include:

*Music Composer/Player Piano.* Stores four simple tunes which can be played, or new ones substituted.

*Typing Tutor.* Provides some finger exercise for the typing student and monitors his performance.

*Checkbook/Budget Manager.* A well-done program that provides a month-by-month checkbook balancing and budgeting function and tells you how well you are doing within each budget category.

*Math Tutor.* Not reviewed.

*Perception I.* A game where two players compete in recognizing shapes, letters and numbers.

*Space, Size and Surface Guide.* A program for computing areas and costs to cover them—with grass seed, tiles, paint and what have you. For the price of this program, you could buy three APF calculators, which would be more useful.

*Personal Business Machine.* Calculates interest rates, mortgage payments and the like. Runs very slowly and gives the wrong answers.

*Budget Manager II.* Keeps a detailed record of expenses in 13 different categories (such as food, rent and auto) and provides totals and summaries. Like most of the home finance programs, this one would be much more useful if a printer were available to print the results.

*Artist and Easel.* Used to "draw" six different still pictures on the screen and display them either one at a time or in sequence.

*Bar Charts.* Not reviewed.

*Spelling Duel.* An interesting game for kids as well as grown-ups, similar to Scrabble but played on the TV screen.

*Electronic Files.* Not reviewed.

*Adventure Castles.* Not reviewed.

*Billboard/Message Center.* A very interesting program which implements a new language specifically for setting up interesting video displays. A variety of commands, such as CURTAIN to create a mock curtain on the screen to cover and uncover text, makes for an interesting display and

ideal sales presentations. (With a camera and good-quality TV set, this program could make varied and eye-pleasing slides for illustrated lectures.)

*BASIC Tutor.* Not reviewed, but should be essential for the beginner, since the BASIC language manual supplied with the system is more of a reference manual for the experienced user.

*Computer Lab.* Not reviewed. Teaches basics of computers and assembly language.

*Jumbled Up Things.* Not reviewed.

Most APF program cassettes are either $19.95 or $29.95; the BASIC Tutor is priced at $49.95. Undoubtedly, other cassettes and cartridges will be available in the future from APF and others.

Disk programs scheduled for early release include an accounts receivable package, mailing list program, machine-language editor and assembler and a Visicalc-like program for general record keeping.

In addition to purchased software, it is, of course, also possible to write your own. Since the Imagination Machine has a fairly capable BASIC, a variety of business, entertainment and educational programs can easily be written and saved on cassette. Unfortunately, APF string usage is completely different from most other small systems, and so it would be difficult to take a program from a magazine and convert it to the Imagination Machine.

Writing BASIC programs is somewhat difficult for another reason as well. Since the display is only 32 characters wide, and the BASIC interpreter inserts a number of extra spaces around keywords, virtually every BASIC statement will wrap around the end of the line. This makes BASIC programs very hard to read. For instance, while it is possible to LIST the programs from APF cassettes on the screen, in many cases the screen will contain only two or three statements, spread out over many lines each. This is compounded by the fact that there is no way to temporarily pause while listing—thus, you never know how many lines to LIST in order to fill up, but not exceed, one screen-full. Each time you resume, you must type in a new LIST command with the required line numbers.

For this reason an external terminal or printer, connected via the RS-232C port, is almost indispensable for any kind of serious programming, whether it be in BASIC or machine language.

APF BASIC has another quirk that is sometimes awkward. When running, a program can be interrupted by pressing the break key on the keyboard. However, this key does not work while the program is looking for an input. Thus, in simple programs which have a lot of input statements in a row, it may not be possible to hit the



✓ Reader Service—see page 257

break key at just the right time for it to be recognized.

On the other hand, the Imagination Machine is very easy to program in machine language. There is a monitor in the BASIC ROM with which you can examine or modify memory; this makes the job easy. The technical reference manual has detailed programming information. Moreover, the 6800 processor is probably the easiest one to learn and use. A number of schools use it in programming courses for that reason.

### The DOS

The DOS, or disk operating system, is contained inside the BASIC ROM cartridge and provides one of the simplest—and fastest—systems yet. It essentially has four commands:

INIT initializes a blank disk to format the sectors and set up an empty directory. Unlike many other disk systems, initializing a disk takes only a few seconds.

DIR displays the directory of a disk.

SAVE "file-name" saves a BASIC program on the disk. The special form SAVE "file-name" K is used to delete a file.

RUN "file-name" loads a file from disk for running.

The disk can also be used for data files, though file storage is not as convenient as on some other systems.

BASIC's OPEN and CLOSE statements open and close a disk file; up to four different files can be open at the same time.

Data files can be either sequential or random, but in both types the file is divided into 256-byte records, and a file can contain a maximum of 127 records. Thus, the maximum file size is just under 32K. Though this is an adequate size, the fact that each record is a self-contained entity and data fields cannot cross record boundaries sometimes makes packing data into a record somewhat difficult, if it is necessary to squeeze every last byte into a file.

### Summary

The APF Imagination Machine is an interesting system not just for the casual programmer, but even for a person interested in the technical aspects of what makes it tick. It contains quite a few features which other systems don't have—such as the built-in cassette recorder with separate data and audio tracks. Its ability to control the audio playback and motor during program execution makes it quite useful for educational programs.

A good variety of accessories and interfaces is available to expand the system at moderate cost; certainly the System II with its expansion box, disk interface and disk drive provides a lot of equipment for its price.

Since APF provides full technical information—including complete diagrams, printed-circuit board parts layouts, timing diagrams, program listings and other information—interfacing other equipment or writing more fundamental programs is not difficult. (And for someone interested in learning about computers, the Imagination Machine could provide an excellent teaching and experimental tool.)

On the other hand, the software has some rough edges. APF BASIC has quirks which make conversion of programs difficult. It is slow and lacks many string and arithmetic functions that are often needed. Hopefully, the new Level II BASIC cartridge will be a significant improvement.

Although some of the program cassettes are quite good, many are trivial and not interesting after the first 15 minutes. Since they are expensive (the complete set of 18 costs almost $500), it becomes important to choose well and carefully. (But this is a common problem with other "appliance" computers as well.)

Perhaps the best way to summarize the system is by comparing it with some of its competition. In terms of the TRS-80, I would place it somewhere between a Level I and a Level II system. Its great advantage is color graphics and simplicity—even with a disk system—but like most systems designed for use with a color set, the color graphics are coarse and the alphanumeric display has short lines.

There is, unfortunately, no easy way to couple the Imagination Machine to a color monitor, so its graphics quality greatly depends on the TV set you use with it.

The Imagination Machine is, of course, less expensive than an Apple II. Its BASIC is somewhat better than Apple's Integer BASIC, but not as good as the optional Applesoft BASIC. In terms of future expansion, there is a much greater variety of add-ons for the Apple. When a good color monitor is used with the Apple, the graphics output looks much better.

In overall capability, the Imagination Machine compares well with the Atari 400 (which, with its optional cassette recorder, lists for about $100 more). The APF keyboard is better, but nothing can compare with the speed of Atari graphics!

Ultimately, the question arises—is the Imagination Machine a game or is it a serious computer? When you really think about it, no system which relies on the coarse detail and definition of a standard color TV can really ever be a serious computer. (Even the twice-as-expensive Apple II requires an extra black-and-white video board for serious use with programs such as Visicalc.) But taken as a game, an educational machine or a vehicle for home finance applications, the Imagination Machine stacks up well against the competition. ■

# MATTERS OF CHOICE FOR MANUFACTURING SYSTEMS

*Don Ludlum, President and Founder of Ludlum Measurements, Inc. is shown with several of the Radiation Detection Products which are manufactured by the company. Ludlum Measurements, Inc. received the Texas Governor's Industrial Expansion Award in 1975.*

*THE COMPANY:*
*LUDLUM MEASUREMENTS, INC.*
*SWEETWATER, TEXAS*

Ludlum Measurements, Inc. was organized in 1962 for the design and manufacture of proprietary radiation detection safety instrumentation. The development and use of radiation sources has moved far beyond X-Ray machines and this new growth has required the development of more sophisticated methods of measuring radiation. From these new applications has developed the need for products which increase the level of nuclear safety. Products were developed by Ludlum Measurements for monitoring nuclear power generating plants, nuclear gauging and servicing applications, nuclear medicine research, energy conservation and research, oil field tubing inspection needs,. and many areas of environmental control. Ludlum Measurements has grown from a small sales volume and workforce to a multi-million dollar company employing over 80 people. This growth has created jobs, provided training, and contributed to the overall economic growth of the area. For this contribution the company received the Texas Governor's Industrial Expansion Award in 1975.

"This growth has not been without its problems, particularly in a manufacturing company. The increased sales and labor force meant new challenges for planning and control of the operation," Don Ludlum, Founder and President comments.

*The modern production facility at Ludlum Measurements, Inc. employs approximately eighty people. With many different production work orders active at any given time, and many items entering and leaving the stock room, requires the MSI computer system for effective inventory management and control.*

"The requirements for increased information obviously lead many companies to consider computerization. The consideration of a computer for a manufacturing company is many times stimulated more by sheer growth than anything else. Coping with increased buying levels, projecting component demands, scheduling production runs, all become larger more complex tasks. We even had a service bureau for some four years, but the costs kept getting higher and we had special problems requiring manufacturing oriented software different than the service bureau could offer."

"We considered IBM and NCR because of name and reputation, but found very quickly that making the right choice was more than a matter of the right name or even price for that matter. We needed an approach that would meet OUR needs. We did a thorough search and we think we made a reasonable judgment of the systems on the market and chose MSI. Based upon the product, software and support, we are glad we chose MSI."

*The production of many different models of radiation detection instrumentation requires an inventory of several thousand individual items and subassemblies.*

## "REAL WORLD" MANUFACTURING ISSUES

Selecting an inventory computer system today involves the evaluation of many different system elements. While the capital costs have come down dramatically, the decision is still very critical because of the tremendous value of OUR information stored and handled by the system. We found several issues to be key to our decision to buy the MSI system.

**TIME LAGS** - not having the information when you need it. Often the cause of stock shortages and untold production delays. Some of the features we needed were:

- On-line data base with interactive file management
- Immediate file updating as parts are received from vendors or drawn for production

**MANUFACTURING INEFFICIENCIES** - production scheduling, materials planning, not knowing the optimum production lot size, incomplete job costing, all impair production efficiency. We wanted the following as a way of avoiding these problems:

- Manufacturing forecasting
- Reorder lists-by part number, vendor, etc.
- Job costing functions
- Where used reports, bill of materials explosions, substitution info.
- Production pick lists

**INVESTMENT MANAGEMENT** - ordering only what you need from real time information. Maintaining proper inventory controls means increased inventory turns on smaller dollar level ..... in all better Return On Investment.

To meet these objectives we needed:

- Monitoring of inventory on hand, even by location
- Current investment dollars and units
- Complete transaction files and audit trails
- Purchase order files showing quoted price, delivery, and backorder information.
- Complete history files for each inventory item showing delivery and utilization data for every item

**COST ACCOUNTING** - a profitable production operation can only be achieved by careful monitoring of production costs, both material as well as labor. We therefore wanted the following system capabilities:

- A Bill of Materials program with complete materials, labor, and overhead cost breakdown.
- A job costing feature which associated all inventory withdrawals with the appropriate job number
- Monthly job cost analysis reporting
- Payroll programs with labor job cost analysis

**SUPPORT** - all systems need support or service at one point or another. Making sure it is available is important. After all Sweetwater, Texas is not New York. We considered it very important that MSI offered:

- Automatic program enhancement availability
- Full service support
- Modem communications with MSI to provide On-line system diagnostics and software support.

## OUR DECISION - MSI

**THE IMPACT** - The use of computers is better understood by business every day. They save time, make more information available, and usually improve the quality of that information. These all relate to the basics of business planning, implementation and control. **The MSI system and personnel delivered for us.**

Small business is free to choose many options. The Strategic Issues of the 1980's will be making the right choices from ever increasing alternatives. We have the products - Hardware, Software, Service and we have the EXPERIENCE, over ten years in the field.

Consider MSI, evaluate us, and we think you'll buy from us - over 3000 have!

If you would like to know how an MSI computer system can help you make your business more profitable, call or write, Midwest Scientific Instruments, 220 W. Cedar, Olathe, KS 66061, 800-255-6638, Telex 42525(MSI A OLAT).

**MSI ......... Helping to make your business run better.**

# SOFTWARE FOR OSI

OSI OSI

## A JOURNAL FOR OSI USERS!!

The Aardvark Journal is a bimonthly tutorial for OSI users. It features programs customized for OSI and has run articles like these:

1) Using String Variables.

2) High Speed Basic On An OSI.

3) Hooking a Cheap Printer To An OSI.

4) An OSI Disk Primer.

5) A Word Processor For Disk Or Tape Machines.

6) Moving The Disk Directory Off Track 12.

Four back issues already available!
$9.00 per year (6 issues)

## ADVENTURES

Adventures are interactive fantasies where you give the computer plain English commands (i.e. take the sword, look at the control panel.) as you explore alien cities, space ships, ancient pyramids and sunken subs. Average playing time is 30 to 40 hours in several sessions. There is literally nothing else like them — except being there yourself. We have six adventures available.

**ESCAPE FROM MARS** — Explore an ancient Martian city while you prepare for your escape.

**NUCLEAR SUBMARINE** — Fast moving excitement at the bottom of the sea.

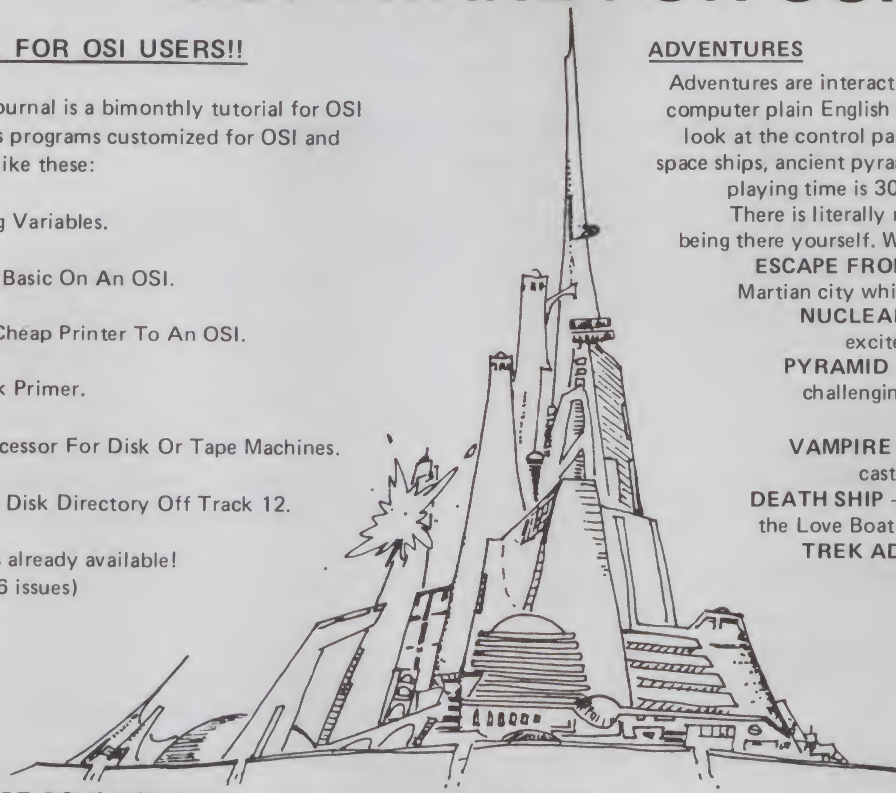
**PYRAMID** — Our most advanced and most challenging adventure. Takes place in our own special ancient pyramid.

**VAMPIRE CASTLE** — A day in old Drac's castle. But it's getting dark outside.

**DEATH SHIP** — It's a cruise ship — but it ain't the Love Boat and survival is far from certain.

**TREK ADVENTURE** — Takes place on a familiar starship. Almost as good as being there.

**$14.95 each**



## NEW SUPPORT ROMS FOR BASIC IN ROM MACHINES

**C1S** — for the C1P only, this ROM adds full screen edit functions (insert, delete, change characters in a basic line.), Software selectable scroll windows, two instant screen clears (scroll window only and full screen.), software choice of OSI or standard keyboard format, Bell support, 600 Baud cassette support, and a few other features. It plugs in in place of the OSI ROM. NOTE: this ROM also supports video conversions for 24, 32, 48, or 64 characters per line. All that and it sells for a mesly $39.95.

**C1E/C2E** for C1/C2/C4/C8 Basic in ROM machines.
This ROM adds full screen editing, software selectable scroll windows, keyboard correction (software selectable), and contains both an extended machine code monitor and a fix for the string handling bug in OSI Basic!! It has breakpoint utilities, machine code load and save, block memory move and hex dump utilities. A must for the machine code programmer replaces OSI support ROM. Specify system! $59.95

**STRING BUG FIX** (replaces basic ROM chip number 3)
All this chip does is to replace the third basic ROM and correct the errors that were put into the ROM mask. $19.95

## DATA SHEETS

**OS65D LISTING**
Commented with source code, 83 pages. $24.95

**THE (REAL) FIRST BOOK OF OSI**
65 packed pages on how OSI basic works. Our best selling data sheet. $15.95

***OSI BASIC IN ROM***
Ed Carlson's book of how to program in basic. Now available from Aardvark. $8.95

## P.C. BOARDS

**MEMORY BOARDS!!** — for the C1P. — and they contain parallel ports!
Aardvarks new memory board supports 8K of 2114's and has provision for a PIA to give a parallel ports! It sells as a bare board for $29.95. When assembled, the board plugs into the expansion connector on the 600 board. Available now!

**REAL SOUND FOR THE C1P** — and it's cheap! This bare board uses the TI sound chip to give real arcade type sound. The board goes together in a couple of hours with about $20.00 in parts. Bare board, plans, and sample program — $15.95

## ARCADE AND VIDEO GAMES

**ALIEN INVADERS** with machine code moves — for fast action. This is our best invaders yet. The disk version is so fast that we had to add selectable speeds to make it playable.
Tape - $10.95 — Disk - $12.95

**TIME TREK** (8K) — real time Startrek action. See your torpedoes move across the screen! Real graphics — no more scrolling displays. $9.95

**STARFIGHTER** — a real time space war where you face cruisers, battleships and fighters using a variety of weapons. Your screen contains working instrumentation and a real time display of the alien ships. $6.95 in black and white - $7.95 in color and sound.

**SEAWOLFE** — this one looks like it just stepped out of the arcades. It features multiple torpedoes, several target ships, floating mines and real time time-to-go and score displays. — $6.95 in black and white $7.95 in color and sound.

## SCREEN EDITORS

These programs all allow the editing of basic lines. All assume that *you are using the standard* OSI video display and polled keyboard.

**C1P CURSOR CONTROL** — A program that uses no RAM normally available to the system. (We hid it in unused space on page 2). It provides real backspace, insert, delete and replace functions and an optional instant screen clear.
$11.95

**C2/4 CURSOR.** This one uses 366 BYTES of RAM to provide a full screen editor. Edit and change lines on any part of the screen. (Basic in ROM systems only.)

**FOR DISK SYSTEMS** — (65D, polled keyboard and standard video only.)

**SUPERDISK.** Contains a basic text editor with functions similar to the above programs and also contains a renumberer, variable table maker, search and new BEXEC* programs. The BEXEC* provides a directory, create, delete, and change utilities on one track and is worth having by itself. — $24.95 on 5" disk - $26.95 on 8".

## DISK UTILITIES

**SUPER COPY** — Single Disk Copier
This copy program makes multiple copies, copies track zero, and copies all the tracks that your memory can hold at one time — up to 12 tracks at a pass. It's almost as fast as dual disk copying. — $15.95

**DISK CATALOGER**
This utility reads the directory of your disks and makes up an alphabetic list off all your programs and what disks they are on. $14.95

**MACHINE CODE RENUMBERER**
(C2/4-MF only)
Renumbers all or part of a program at machine code speeds. — $15.95

**This is only a partial listing of what we have to offer. We now offer over 100 programs, data sheets, ROMS, and boards for OSI systems. Our $1.00 catalog lists it all and contains free program listings and programming hints to boot.**

91

**Aardvark Technical Services • 1690 Bolton • Walled Lake, MI 48088**
(313) 669-3110 or (313) 624-6316

OSI OSI

# SAY MERRY CHRISTMAS with kilobaud MICROCOMPUTING™

Give a year of the industry's most informative journal—Kilobaud Microcomputing offers more pages of articles each month than any other microcomputing journal

Yes, I'll give a year of Kilobaud Microcomputing for Christmas (1 year/$25.00)

☐ Bill me for a one year gift subscription for $25.00

My Name ______

Address ______

City ______ State ______ Zip ______

Please enter a one year gift subscription to:

Name ______

Address ______

City ______ State ______ Zip ______

Canadian $27/1 year only. US funds. Foreign $35/1 year only. US funds.

Please allow 4-6 weeks for delivery.

Kilobaud Microcomputing • Box 997 • Farmingdale NY 11737 60DB4B

All Christmas gift subscriptions will begin with the January 1981 issue.


# SAY MERRY CHRISTMAS with kilobaud MICROCOMPUTING™

Give a year of the industry's most informative journal—Kilobaud Microcomputing offers more pages of articles each month than any other microcomputing journal

Yes, I'll give a year of Kilobaud Microcomputing for Christmas (1 year/$25.00)

☐ Bill me for a one year gift subscription for $25.00

My Name ______

Address ______

City ______ State ______ Zip ______

Please enter a one year gift subscription to:

Name ______

Address ______

City ______ State ______ Zip ______

Canadian $27/1 year only. US funds. Foreign $35/1 year only. US funds.

Please allow 4-6 weeks for delivery.

Kilobaud Microcomputing • Box 997 • Farmingdale NY 11737 60DB4B

All Christmas gift subscriptions will begin with the January 1981 issue.

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

**BUSINESS REPLY CARD**
FIRST CLASS PERMIT NO 17 PETERBOROUGH NH 03458

POSTAGE WILL BE PAID BY ADDRESSEE

kilobaud
MICROCOMPUTING T.M.

**Subscription Department • Box 997**
**Farmingdale NY 11737**

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

**BUSINESS REPLY CARD**
FIRST CLASS PERMIT NO 17 PETERBOROUGH NH 03458

POSTAGE WILL BE PAID BY ADDRESSEE

kilobaud
MICROCOMPUTING T.M.

**Subscription Department • Box 997**
**Farmingdale NY 11737**

# Good Times, Bad Times With the Compucolor II

*This author, as one of the system's early users, predicts a colorful future for this computer, despite a lack of suppliers at present.*

**The Compucolor II. (Photo courtesy of Intelligent Systems Corp.)**

*Barry L. Parr*
*2400 Alvin St.*
*Mountain View, CA 94043*

I have a love/hate relationship with the Compucolor II. It's got more power than any microcomputer in its price range, its BASIC is as extensive and versatile as anything on the market, it offers all sorts of features as standard equipment and its graphics are brighter and sharper than anyone else's. Yet, with only a few thousand machines in the field, not much independently developed software and hardware is available.

I was attracted to the unit by its price/performance ratio and color graphics. It's doubtful that anyone can match Compucolor's array of features for the money: full-color monitor, 16K RAM, RS-232 port, floppy disk drive, 128 × 128 graphics and complete floating point BASIC for $1795. The competition weighs in at around $2400, and some of them don't even have all these features.

(The monitor situation makes cost comparisons difficult. The Apple and Atari prices include the cost of a color television set, which the buyer may already have.)

Also, Compucolor's dedicated monitor produces sharp, stunning colors that surpass anything that can be done with a color TV and an rf modulator. The colors are brighter, the edges of the graphics much sharper and the resolution on characters superior.

Also, you can produce 32 lines of 64 char-

acters. This gives you 2048 characters per page, better than a standard terminal at 1920 characters, let alone a TRS-80 (1024), PET (1000), Apple (960) or Texas Instruments (768).

### System Features

The Compucolor is expandable to 32K RAM, which is enough for most programmers. Keep in mind that every byte of this is available to the user, because the Compucolor also has 17K of ROM (Microsoft BASIC, disk operating system and added graphics commands) and 8K of dedicated screen memory.

The RS-232 port is a nice touch. Given current printer prices, some users may want to forego the luxury. This would certainly make the Compucolor's price less attractive. However, you can get an inexpensive ($29.95) sound generator that attaches to the port from CAP Electronics (8462 Hillwood Lane, Ste. 2, Tucson, AZ 85715).

There are some problems with the port. It will not perform the handshaking needed for transfer rates over 300 baud without a simple, inexpensive hardware fix. Also, you might have some problems interfacing the Compucolor with certain printers. You had better make sure that it works with the printer that you have in mind.

Of course, the floppy disk is a big feature. You will wonder how anyone can program without it. In addition to a good DOS, Compucolor has an excellent series of random access file commands.

While the disk only accommodates 52K bytes of data, keep in mind that 17K of ROM means you don't have to keep DOS or BASIC in drive one, as some personal computers require. There is plenty of room to store several versions of any program, and there should be enough room for most personal data bases on a single diskette.

The disk is the Compucolor's weak link. Early units seem to be the worst. It's a good idea to avoid Compucolors whose serial numbers are before 103000. They have trouble staying aligned, and a disk recorded on one unit may not be readable by another. Compucolor claims to have corrected this problem around August 1979. When "CPU Reset" is pressed on the new machines, they will show they are using BASIC version 8.79.

Also, the early drives were not well-shielded, and picked up considerable interference from the monitor with which they share a cabinet.

As might be expected, the Compucolor's add-on drives are much more reliable. Unless I am copying disks, I use my add-on drive almost exclusively.

Finally, if you need lots of storage, eight-inch floppies will be available soon. They have been used for years with CC's big brother, the Intecolor.

When the Auto button is pressed, Compucolor automatically loads and runs the last version of any program on the disk called MENU. This is a terrific feature for creating turnkey systems, or for programs you use a great deal. Because programs can be chained, MENU can load other programs on the diskette. The combination control-A also loads MENU, and the proximity of the control and A keys makes this a little dangerous. Also, because of the way the plot commands are set up, a badly written program also risks loading the MENU on top of itself.

### Graphics

Compucolor's graphics are stellar. You can choose between 16 submodes to plot points, lines, vertical bar graphs and horizontal bar graphics, and incremental modes that permit extensive control of the widths of all of these plots. Other plot commands switch between small and large characters, special character sets, blink modes and foreground and background colors. In fact, any mode can be entered or the output specified through the plot commands.

**Compucolor's graphics are stellar . . . . The use of graphics is flexible. You can use all eight colors at once in 128 × 128 graphics. You can mix graphics and alphanumerics on the screen and specify foreground and background colors.**

The bad news is that aside from the word PLOT, all of the commands are numbers—numbers that can take on new meanings depending on their position in the command. As in machine-language programming, unless you know the previous instruction, you can't tell whether a particular byte is an instruction or data.

For example, the command PLOT 6,2 can have several meanings. By itself, it changes the screen color (PLOT 6) to green foreground and black background (PLOT 2). Preceded by PLOT 2, it means to plot a point at coordinates (6,2). Preceded by PLOT 3, it means to move the cursor to the sixth character position of the second line. Preceded by other plot commands, it can define the length and position of a vertical or horizontal bar graph or the end point of a line.

This may all seem complicated, but it does not take long to learn the codes. Once you become used to them, the Plot command becomes a concise and powerful tool.

The use of graphics is flexible. You can use all eight colors at once in 128 × 128 graphics. You can mix graphics and alphanumerics on the screen and specify foreground and background colors.

You are limited to two colors in each of the 2048 character blocks. This is not much of a limitation. This flexibility is the result of dedicating 8K of RAM to the screen. In any of the 32 × 64 character blocks on the screen, you can specify foreground and background color, blink and whether it contains graphics or alphanumerics. Each character block is divided into eight plot blocks, which can be turned on or off individually. Because there are eight blocks, they can be represented in memory by a single byte.

The screen memory organization gives the system some of its graphics power. Remember that the screen can hold 2K characters. Associated with each character is a status byte that specifies any of eight foreground and background colors, character type and blink status. This adds up to 4K.

Finally, there is a fast and a slow screen memory, doubling the total screen memory to 8K. Among other things, this memory arrangement lets you mix graphics and characters on the screen in any combination of positions and colors without having to worry about memory restrictions or other constraints. This memory arrangement makes it easy to save screen displays on the disk. Carefully constructed displays (for example, a graph or a game board) can be saved as a 4K byte data file with a few simple instructions and called up for later use.

There is also a collection of high-resolution special characters that can be used to create excellent displays (if you have the patience). In addition to lines and corners, there are parts of extra-large characters (four times the size of the regular character set), chess pieces and playing card suits.

Unfortunately, the graphics section of the Compucolor programming manual is inadequate. While the chapters on the BASIC language are passable, this information can be found in any of a number of sources. When describing the graphics and file systems, the two unique features of the system, the text lapses into incoherence. Compucolor has recognized this and has purchased an improved graphics manual. I've read the new manuscript, which will be

a big improvement. But there is no telling when this will be available.

As one of the early users of the machine, I was on my own in learning to use it. Once I called Compucolor about a simple, but important, software question. After four tries, I found someone who knew the answer to my question.

"Golly," I said, "that's pretty important. And it's not in the manual." The voice on the other end of the line was sympathetic. "I know," he said, "I learned by accident."

I learned how to program Compucolor's graphics by trial and error. The manual taught me little more than the names of the graphics submodes. (In the revised manual I wrote for friends, I even changed many of these names in order to make them more descriptive.) How they actually worked was incomprehensible to me.

But I persevered, and within a couple of months I was teaching the graphics commands to other bewildered beginners in our Compucolor users group. The graphics can be powerful once under control.

### The Disk

As I mentioned, the other flaw in the documentation was its coverage of the random access file system.

Like most personal computer buyers, I didn't even know what a random access file was when I first sat down at the machine. The manual was of no help. This is one of the most poorly documented areas of personal computing in general, due, no doubt, to the relatively recent advent of the floppy disk.

I managed to piece together a conceptual notion of files using *BASIC and the Personal Computer* (HP and DEC software), *The User's Guide to North Star BASIC*, and the Apple Cart column in *Creative Computing*. Thus armed, I was able to tackle Compucolor's unique syntax.

As with the graphics, the file commands are powerful once you get a handle on them. In addition to commands to open, close, get, put and create files, there are two commands for file error trapping, variable-sized buffers for getting as much of your file into RAM as possible to avoid tedious disk accesses, and commands to dump modified buffers without closing a file and to output the attributes of a file. You have immediate access to any of 52,000 bytes of information on the disk.

You can also read and write any part of RAM to any place on the disk and vice versa. These are the commands that permit saving screen displays on the disk. You can chain programs, enter FCS and use DOS commands while in BASIC programs (copy, delete, set defaults, print directories, initialize disks, load and run machine-language programs and rename files). You can even save on the disk the contents of any array that you have used in a program and recall it for future use.

**Compucolor has not done much to encourage the independent development of software, but has been doing a good job of supplying its own.**

The documentation crisis has been relieved since I learned to program the Compucolor. CC's *Colorcue* newsletter has done a good job of alleviating many of the gaps in the programming manual. Also, several local users groups offer help. Compucolor is now willing to sell a documented listing of its ROMs for $100 (excluding, of course, the portion owned by Microsoft).

The one remaining problem is that the microcomputing press has yet to publish a single article on how to get more out of your Compucolor. This is a serious problem.

### Hardware Options

You will probably have to pay CC's list price for memory upgrades, although some independents may do it for less. To go from 16 to 32K requires an additional circuit board and a ROM.

There are two keyboard options. The intermediate keyboard adds a numeric keypad, which can be convenient, and a color keypad, which is not very useful. The top-of-the-line keyboard includes a set of graphics keys that let you draw pictures on the screen in immediate mode. I have the keys and have never used this option. But there is a good word-processing program for the Compucolor that uses these keys. Lowercase is available on ROM for around $100. It lacks descenders, but is useful for humanizing your programs and necessary for word processing.

### Software

Compucolor has not done much to encourage the independent development of software, but has been doing a good job of supplying its own. Unfortunately, you must adapt to the problems of having to rely on a single source for your software and live with whatever schedule it wishes to impose. A fairly complete listing of all the software available for the Compucolor follows.

*Compuwriter*—This is a very good word-processing program. It includes a set of keycaps that fit on the expanded keyboard and turn the Compucolor into the nearest thing to a real word processor that you are going to find on a microcomputer. It comes with an excellent manual and costs around $200.

*Text Editor and Assembler*—One is useless without the other. No, Virginia, the Text Editor is not a word processor, nor will it edit BASIC programs. A new screen editor for the assembler is now available.

*BASIC Editor*—This is an excellent program that corrects a major failing of the machine. Compucolor now has an editor that is better than that on any personal computer I know of. An absolute necessity.

*Formatter*—In the Dark Ages (1979), the Compucolor could not format its own diskettes. The company figured they could get rich selling preformatted Verbatim diskettes at $10 apiece. People figured out how to format diskettes in the field, and when dealers started to do it, Compucolor stomped on them. But the marketplace finally forced Compucolor to cough up the format program. While Compucolor now sells preformatted diskettes for $5, this program is still another necessity.

*Star Trek*—A good version. Nice graphics, but it lacks instructions. They figure everybody knows how to play by now.

*Chess*—Plays a terrible game; likes to use its bishops. Chess pieces are special characters, so the display is impressive.

*Othello*—Plays a pretty good game, but once you understand its strategy, you can give it a drubbing.

### Conclusion

When the Compucolor first came on the market, it was plagued with the sorts of problems that trouble any beginning system. It also had the problem of being the stripped-down version of an advanced business machine.

The manufacturer now seems to have dedicated itself into turning it into a serious personal computer. It is an excellent base on which to build that market. For *all* its faults, I am impressed with the computing power that Compucolor offers for such a low price.

My only strong objection to the system is that there are not many suppliers—other than the manufacturer—you can count on. If you're interested in music, speech synthesis, voice recognition, hard disks or other fancy peripherals, the Compucolor is not the system for you.

On the other hand, if you want a powerful BASIC computer, color graphics, disk and serial port for well under $2000 and plan to write most of your own applications software; if you are not intimidated by generating some of your own documentation; and if you like the challenge of unraveling the intricacies of a powerful computer system, give the Compucolor a good, close look. ■

# How's your love life?


A little dull around the edges? Routine? Predictable? Boring? Maybe all it needs is a little Interlude. Interlude is the most stimulating computer game ever conceived. It combines a computer interview, an innovative programming concept, and a one-of-a-kind manual to turn your love life into exciting, adventurous, delicious fun!

**Interlude is:** romantic... playful... outrageous... a fantasy. Interlude is: ■ A Bed of Roses (Interlude #1) ■ Mata Hari (Interlude #49) ■ The Chase (Interlude #7) ■ Rodeo! (Interlude #71) ■ The King and I (Interlude #60) ■ Some Enchanted Evening (Interlude #84) ■ Caveman Caper (Interlude #82) ■ From Here to Ecstasy (Interlude No. 30) ■ Satin Dreams (Interlude #72).

More than 100 Interludes are included in the program. Most are described in detail in the accompanying manual, but several surprise Interludes are buried in the program awaiting that very special time when your interview says you're ready. (When you learn secret Interlude #99, your love life may never again be the same!) Interlude can give you experiences you'll never forget. Are you ready for it?

**Interlude**™
**The Ultimate Experience.**

235

**INTERLUDE,** 10428 Westpark, Houston, Texas 77042. I'm really ready. Send my Interlude today.

**Apple II** (16K)*
☐ Cassette ($16.95)
☐ Diskette ($19.95)
☐ Diskette—Pascal or DOS 3.3 ($19.95)
Add $1.50 for shipping and handling.

**TRS-80** (Level II-16K)**
☐ Cassette ($16.95)
☐ Diskette ($19.95)

**Poster**
☐ 20″x 24″ reproduction of this ad without ad copy ($4.95—includes shipping charges)

**Available for immediate shipment.**

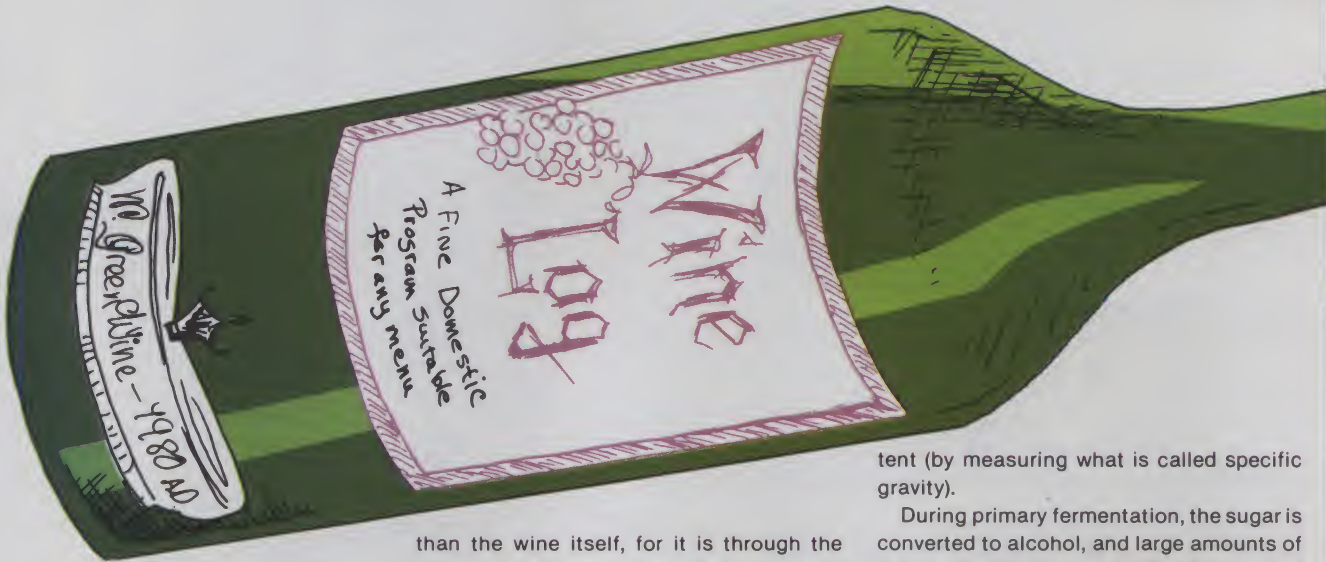
Please enclose your check payable to INTERLUDE or complete the charge information:

☐ MASTERCARD ☐ VISA All charge customers must sign here. ______________________
Account No. ______________ Expiration date ________ MasterCard Bank Code ________

**CHARGE CUSTOMERS:** Order by phone toll-free! **1-800-231-5768 Ext. 306** (Texas: 1-800-392-2348 Ext. 306)
Name ______________________ Age ________
Address ______________________
City ______________ State ________ Zip ________

*Apple II is a registered trademark of Apple Computers, Inc. **TRS-80 is a registered trademark of Radio Shack, a Tandy Co.

# Wine Log Program




*Thomas W. Glaser*
*Route 1, Box 312*
*Rochester, MN 55901*

According to the poet Hesiod, wine was first invented on Mount Nysa in Libya by Dionysus, son of Zeus. From there, as told in Greek legend, vine culture crossed the Mediterranean to Crete and Greece, where the ritual of wine drinking became part of the Dionysian cult.

Other legends place the origin of winemaking in other parts of the world in differing times. The Bible, for example, says it started with Noah after the great flood.

But whatever its roots, the art of transforming the juices of the grape or other fruit into a flavorful and often subtle beverage has flourished throughout the world. For many, winemaking in the home has become a popular and fascinating hobby. It combines elements of science and art to yield a delicious by-product.

Some months ago, I mixed my first batch and joined the ranks of home winemakers. But after I had picked up the ingredients for another batch, I realized I had forgotten to also pick up a wine log.

Most amateur winemakers keep a careful record, or log, of the wine's progress. In fact, if a wine should turn out particularly good, the log may become more valuable than the wine itself, for it is through the carefully kept record that the winemaker can best attempt to reproduce the good batch.

The lack of the log could not interrupt the mixing of the batch at hand, but the recording of the ingredients and quantities on the back of a paper bag left much to be desired. Only when my paper sack log landed on the desk that also supports my microcomputer did the advantages of automating my wine logs occur to me.

The program described here specifically provides the necessary features to maintain an accurate and complete log of a wine's progress from initial mixing until after the aging, when the real fun—the tasting and subsequent consumption—takes place.

**What a Wine Log Records**

Depending on the type or variety of wine, the winemaking process can take from several months to several years. For recordkeeping purposes the process can be divided into three distinct stages.

Winemaking begins with the mixing of the ingredients in a large tub called the primary fermentor. The quantities and types of ingredients are carefully recorded, along with any special methods used in the mixing. Also recorded are certain key chemical features of the mixture, called the must, like the relative sugar and acid content.

The yeast is then added to the must, and the phase called primary fermentation begins. During this time, which normally lasts several days, much of the sugar in the mixture is converted to alcohol. The winemaker takes a small daily sample of the mixture and tests it for relative sugar content (by measuring what is called specific gravity).

During primary fermentation, the sugar is converted to alcohol, and large amounts of carbon dioxide gas are released from the mixture. The wine will often appear nearly violent, with much bubbling and popping of the must. The winemaker, in measuring and recording the specific gravity of the must daily, follows the progress of this chemical change. When enough of the sugar has been converted, the process slows down and the liquid part of the mixture can be transferred to a second container, called the secondary fermentor.

The secondary fermentor is a closed container, like a large glass or plastic bottle, with a device called a fermentation lock attached to the filler. The fermentation lock lets the carbon dioxide gas escape from the bottle, but prevents potentially damaging air from entering.

During secondary fermentation, the conversion of sugar to alcohol is completed over some months and the yeast and other sediment settles to the bottom of the fermentor. The winemaker will typically siphon, or rack, the wine several times during this period to remove the sediment and assist the wine in clearing, and records the specific gravity. Also noted at this time are the wine's clarity, color, taste and other observations.

After several months in the secondary fermentor, the wine is ready to bottle. This is the final stage in the process. The wine is transferred to bottles, corks are inserted, and the bottle aging begins.

Depending upon the type of wine, this period may be from a few months to several years. Little is recorded during this period until the moment of truth when the first bottle of the batch is uncorked. At this time the winemaker completes the log by giving his

# for SWTP

*Listing 1. Wine-log program in SWTP BASIC.*

```
0010 LINE= 80:W=4:REM W IS # OF BATCHES/CASSETTE
0020 DIM C$(29),A$(W,68)
0030 REM WINE-LOG VERSION 6-29-80 WRITTEN BY TOM GLASER
0035 FOR I=1 TO 29:READ C$(I):NEXT I
0038 DATA "BATCH NUMBER","TYPE OF WINE","AMOUNT","YEAST STRAIN"
0039 DATA "DATE STARTED","BASE OR FRUIT TYPE","AMOUNT OF WATER"
0040 DATA "AMOUNT OF SUGAR","CAMPDEN TABLETS","YEAST NUTRIENT"
0041 DATA "GRAPE TANNIN","PECTIC ENZYME","ACID BLEND","OTHER"
0042 DATA "METHOD","INITIAL SPECIFIC GRAVITY","INITIAL ACID TEST"
0043 DATA "TEST DATE","SPECIFIC GRAVITY","COMMENT","RACK DATE"
0044 DATA "BOTTLE DATE","BOUQUET","FLAVOR"
0045 DATA "BODY","TANNIN","ACID","% ALCOHOL","DRY OR SWEET"
0050 PRINT :PRINT:PRINT:PRINT "WINE-LOG OPTION MENU"
0060 PRINT "SELECT OPTION:"
0070 PRINT "   1 - LOAD WINE-LOG CASSETTE"
0080 PRINT "   2 - SAVE WINE-LOG ON CASSETTE"
0090 PRINT "   3 - CREATE NEW BATCH RECORD"
0100 PRINT "   4 - UPDATE BATCH IN PROCESS"
0110 PRINT "   5 - PRINT WINE-LOG CONTENTS"
0120 PRINT "   6 - PRINT BATCH DETAIL"
0130 PRINT "   7 - END PROGRAM"
0140 INPUT S
0145 ON S GOTO 2200,2000,150,350,850,910,1380
0150 REM NEW BATCH
0170 PRINT "INPUT ";C$(1):INPUT B
0171 IF A$(B,1)="" GOTO 178
0172 PRINT "THERE IS ALREADY A BATCH ";B
0173 PRINT "DO YOU WISH TO OVERWRITE THIS BATCH? (Y OR N)"
0174 INPUT I$:IF I$="N" GOTO 50
0175 FOR I=1 TO 68:A$(B,I)="":NEXT I
0178 A$(B,1)=STR$(B)
0179  A$(B,2)="1"
0180 FOR I=3 TO 14
0185 IF I=7 PRINT "NOW ENTER INGREDIENTS..."
0190 PRINT "ENTER ";C$(I-1):INPUT A$(B,I)
0200 NEXT I
0210 PRINT "ENTER OTHER INGREDIENTS (UP TO 3)"
0220 PRINT "CR ONLY TO METHOD ENTRY"
0230 X=15:Y=17:GOSUB 1500
0240 PRINT "NOW ENTER COMMENTS ON METHOD (UP TO 4 LINES)"
0250 PRINT "CR ONLY TO END"
0260 X=18:Y=21:GOSUB 1500
0270 FOR I=22 TO 23
0280 PRINT "ENTER ";C$(I-6):INPUT A$(B,I)
0290 NEXT I
0300 PRINT "THIS COMPLETES ENTRY OF A NEW BATCH"
0340 GOTO 50
0350 REM THIS IS THE FILE UPDATE ROUTINE
0360 PRINT "WHICH BATCH TO BE UPDATED?"
0370 INPUT B
0400 ON VAL(A$(B,2)) GOTO 410,550,720,830
0410 PRINT "INPUT TEST DATA FOR BATCH IN PRIMARY FERMENTOR"
0420 FOR I=24 TO 42 STEP 3
0430 IF A$(B,I)="" GOTO 450
0440 NEXT I:PRINT "TEST FILE AREA FULL":GOTO 500
0450 FOR J=18 TO 20
0460 PRINT "ENTER ";C$(J)
0470 INPUT A$(B,I)
0480 I=I+1
0490 NEXT J
0500 PRINT "IS THE WINE READY TO MOVE TO SECONDARY FERMENTOR (Y OR N)"
0510 INPUT I$
0520 IF I$="N" GOTO 50
0530 A$(B,2)="2"
0540 GOTO 50
0550 PRINT "INPUT DATA FOR RACKING OF THE WINE"
0560 FOR I=45 TO 57 STEP 4
0570 IF A$(B,I)="" GOTO 600
0580 NEXT I
0590 PRINT "RACK FILE FULL":GOTO 670
0600 PRINT "ENTER ";C$(21)
0610 INPUT A$(B,I):I=I+1
0620 FOR J=19 TO 20
0630 PRINT "ENTER ";C$(J)
0640 INPUT A$(B,I)
0650 I=I+1
0660 NEXT J
0665 INPUT A$(B,I)
0670 PRINT "IS THE WINE READY TO BOTTLE? (Y OR N)"
0680 INPUT I$
0690 IF I$="N" GOTO 50
0700 A$(B,2)="3"
0705 PRINT "ENTER THE DATE OF BOTTLING"
0706 INPUT A$(B,61)
0710 GOTO 50
```

```
0720 PRINT "AH..YOU'VE TASTED IT..."
0730 PRINT "TIME FOR FINAL GRADING OF THE BATCH.."
0740 PRINT "INPUT A COMMENT FOR EACH OF THE FOLLOWING"
0750 FOR I=62 TO 68
0760 PRINT C$(I-39)
0770 INPUT A$(B,I)
0780 NEXT I
0790  A$(B,2)="4"
0800 PRINT "THAT COMPLETES THE LOG FOR THIS BATCH"
0810 PRINT "...ENJOY..."
0820 GOTO 50
0830 PRINT "THIS IS A COMPLETED AND BOTTLED BATCH"
0840 GOTO 50
0850 REM THIS ROUTINE PRINTS A CONTENTS LISTING
0860 PRINT C$(1);TAB(16);C$(2);TAB(32);"STATUS"
0870 FOR B=1 TO 4
0880 PRINT TAB(5);A$(B,1);TAB(16);A$(B,3);TAB(32);
0882 GOSUB 2300
0890 NEXT B
0900 GOTO 50
0910 REM PRINT WINE DETAIL
0920 PRINT "WHICH BATCH TO BE PRINTED?"
0930 INPUT B
0940 PRINT "WINE-LOG FOR WINE BATCH #";B
0950 PRINT "WINE STATUS: ";
0960 GOSUB 2300
1000 FOR I=2 TO 5
1010 PRINT C$(I);TAB(22);A$(B,I+1)
1020 NEXT I
1030 PRINT :PRINT "INGREDIENTS USED:"
1040 FOR I=6 TO 13
1050 PRINT C$(I);TAB(30);A$(B,I+1)
1060 NEXT I
1070 FOR I=15 TO 17
1080 IF A$(B,I)="" GOTO 1110
1085 IF I=15 PRINT "OTHER INGREDIENTS";
1090 PRINT TAB(30);A$(B,I)
1100 NEXT I
1110 IF A$(B,18)="" GOTO 1170
1120 PRINT :PRINT "METHOD USED:"
1130 FOR I=18 TO 21
1140 IF A$(B,I)="" GOTO 1170
1150 PRINT A$(B,I)
1160 NEXT I
1170 PRINT C$(16);TAB(30);A$(B,22)
1171 PRINT C$(17);TAB(30);A$(B,23)
1175 IF A$(B,24)="" PRINT "NO TESTS PERFORMED AS YET":GOTO 50
1180 PRINT :PRINT "TEST RESULTS WHILE IN PRIMARY FERMENTATION"
1190 PRINT C$(18);TAB(12);C$(19);TAB(32);C$(20)
1200 FOR I=24 TO 42 STEP 3
1210 IF A$(B,I)="" GOTO 1240
1220 PRINT A$(B,I);TAB(18);A$(B,I+1);TAB(32);A$(B,I+2)
1230 NEXT I
1240 IF VAL(A$(B,2))<2 GOTO 50
1245 IF A$(B,45)="" PRINT "NO RACKING YET PERFORMED":GOTO 50
1250 PRINT :PRINT "TEST RESULTS AT EACH RACKING"
1260 PRINT C$(21);TAB(12);C$(19);TAB(32);C$(20)
1270 FOR I=45 TO 57 STEP 4
1280 IF A$(B,I)="" GOTO 1310
1290 PRINT A$(B,I);TAB(18);A$(B,I+1);TAB(32);A$(B,I+2)
1295 IF A$(B,I+3)<>"" PRINT TAB(32);A$(B,I+3)
1300 NEXT I
1310 IF VAL(A$(B,2))<3 GOTO 50
1320 PRINT :PRINT "THIS BATCH WAS BOTTLED ON ";A$(B,61)
1325 IF A$(B,2)<>"4" GOTO 50
1330 PRINT "ITS FINAL CHARACTERISTICS WERE"
1340 FOR I=23 TO 29
1350 PRINT C$(I);TAB(20);A$(B,I+39)
1360 NEXT I
1370 GOTO 50
1380 END
1500 REM THIS IS AN INPUT ROUTINE
1510 FOR I=X TO Y
1520 INPUT A$(B,I)
1530 IF A$(B,I)="" RETURN
1540 NEXT I
1550 RETURN
2000 REM OUTPUT ARRAY ROUTINE
2007 PRINT "READY THE WINE-LOG CASSETTE FOR OUTPUT"
2010 INPUT "INPUT CR WHEN TAPE IS READY ",I$
2020 PRINT #2,"C"
2030 FOR I=1 TO W
2040 FOR J=1 TO 68
2050 PRINT #3,A$(I,J);","
2060 NEXT J
2070 NEXT I
2080 PRINT #2,"E"
2090 PRINT "WINE-LOG STORED TO CASSETTE"
2100 GOTO 50
2200 REM INPUT ARRAY ROUTINE
2206 PRINT "READY THE WINE LOG CASSETTE FOR INPUT"
2210 INPUT "INPUT CR WHEN TAPE IS READY ",I$
2220 PRINT #2,"C"
```



final appreciation and comments about the wine.

### The Wine-Log Program

During the three phases just described, the winemaker uses the wine log nearly every time any step is performed. in the first phase, the program required for retaining the key information in the mixing is much like many food recipe programs. But, unlike a food recipe, the winemaking process extends for many months, with data added to the initial recorded information at each step. This characteristic adds the requirement of being able to update or add to the wine log at many points during the process.

To best fulfill these requirements, I chose to represent each wine batch as a set of elements in an array. Each batch has allotted to it 68 distinct possible pieces of information. The definition of the elements in this array for each wine batch is shown in Table 1.

The wine-log program then consists of an option-menu-driven collection of routines designed to operate on the array in various ways. Though modest at the outset, the option menu grew during the program development to include six main routines, which are described shortly.

I also chose to have the entries for all of the routines be made in response to specific operator prompting. This makes operation of the program very simple in that the program's structure guides the winemaker in the recording of key data.

The program (Listing 1) was written in SWTP BASIC version 2.0, but should be easily adapted to other BASIC interpreters. However, the BASIC interpreter must be able to handle data files in one form or another. This is necessary for the input and output routines to read or write the array from or to the cassette storage device.

To minimize memory requirements, the program has few remark statements remaining; thus, a brief explanation of each section will help you understand the program.

Lines 10 to 145 initialize variables and output the option menu to the terminal. Note that in line 10, a user-defined variable (W) allows the number of batches per cassette to be defined. The limitation here is not one of cassette capacity though, but rather the capacity of the system's memory. My system has 24K of RAM (including 8K for the interpreter), which allows four wine batches to be contained on each cassette. If I attempt greater than four, insufficient memory is indicated when the arrays are dimensioned.

The cassette load routine (menu option 1) is contained in lines 2200–2290. This routine simply inputs the array A$ from cassette. My system uses an input driver accessible

```
2230 FOR I=1 TO W
2240 FOR J=1 TO 68
2250 INPUT #0,A$(I,J)
2260 NEXT J
2270 NEXT I
2280 PRINT "WINE-LOG READY FOR UPDATE"
2290 GOTO 50
2300 REM STATUS OUTPUT
2305 IF A$(B,2)="" PRINT:GOTO 2360
2310 ON VAL(A$(B,2)) GOTO 2320,2330,2340,2350
2320 PRINT "PRIMARY FERMENT":GOTO 2360
2330 PRINT "SECONDARY FERMENT":GOTO 2360
2340 PRINT "BOTTLE AGING":GOTO 2360
2350 PRINT "FINISHED":GOTO 2360
2360 RETURN
```

*Table 1. Array elements.*

| ARRAY INDEX | MEANING OF ENTRY |
|---|---|
| 1 | BATCH NUMBER |
| 2 | PRESENT STATE OF WINE<br>1=PRIMARY 2=SECONDARY<br>3=BOTTLED 4=FINISHED |
| 3 | TYPE OF WINE |
| 4 | AMOUNT |
| 5 | YEAST STRAIN |
| 6 | DATE WINE STARTED |
| 7 | BASE OR FRUIT TYPE |
| 8 | AMOUNT OF ADDED WATER |
| 9 | AMOUNT OF ADDED SUGAR |
| 10 | CAMPDEN TABLETS ADDED |
| 11 | AMOUNT OF YEAST NUTRIENT |
| 12 | AMOUNT OF GRAPE TANNIN |
| 13 | AMOUNT OF PECTIC ENZYME |
| 14 | AMOUNT OF ACID BLEND |
| 15-17 | OTHER INGREDIENTS IF REQUIRED |
| 18-21 | COMMENTS ABOUT METHODS USED |
| 22 | INITIAL SPECIFIC GRAVITY |
| 23 | INITIAL ACID TEST |
| 24 | TEST DATE WHILE IN PRIMARY FERMENTOR |
| 25 | TESTED SPECIFIC GRAVITY |
| 26 | OTHER COMMENTS ABOUT TEST |
| 27-29 | SAME AS 24-26 FOR NEXT TEST DATE |
| 30-32 | SAME AS 27-29 |
| 33-35 | SAME AS 27-29 |
| 36-38 | SAME AS 27-29 |
| 39-41 | SAME AS 27-29 |
| 42-44 | SAME AS 27-29 |
| 45 | DATE OF RACKING WHILE IN SECONDARY |
| 46 | TESTED SPECIFIC GRAVITY |
| 47-48 | OTHER COMMENTS ABOUT THE WINE |
| 49-52 | SAME AS 45-48 |
| 53-56 | SAME AS 45-48 |
| 57-60 | SAME AS 45-48 |
| 61 | DATE OF BOTTLING |
| 62 | BOUQUET |
| 63 | FLAVOR |
| 64 | BODY |
| 65 | TANNIN |
| 66 | ACID |
| 67 | % ALCOHOL |
| 68 | DEGREE OF SWEETNESS |

*Listing 2. Sample input.*

```
WINE-LOG OPTION MENU
SELECT OPTION:
   1 - LOAD WINE-LOG CASSETTE
   2 - SAVE WINE-LOG ON CASSETTE
   3 - CREATE NEW BATCH RECORD
   4 - UPDATE BATCH IN PROCESS
   5 - PRINT WINE-LOG CONTENTS
   6 - PRINT BATCH DETAIL
   7 - END PROGRAM
? 4

WHICH BATCH TO BE UPDATED?
? 1

INPUT TEST DATA FOR BATCH IN PRIMARY FERMENTOR
ENTER TEST DATE
? 1-4-80
```

at input port 0 to retrieve data from the cassette interface.

Similarly, the cassette save routine (menu option 2) outputs the contents of the array A$ to the cassette interface. For my system this is performed by outputting the array of the output driver at output port 3. Both this routine and the input routine will have to be modified to satisfy other individual system methods for storage and retrieval of array data. The save routine is contained in lines 2000–2100.

The creation of a new wine batch is selected by option 3 from the option menu. This routine prompts the winemaker through the normal entries made at the time the batch is initially mixed. This includes the ingredients list, methods employed and the initial tests performed on the must. This routine is contained in lines 150–340.

To update a batch in process, option 4 is selected from the menu. The update routine prompts the winemaker through the remaining additions to the wine log and is used for all data entry between the completion of mixing and the final grading of the wine. An example of a typical update during primary fermentation is shown in the first part of Listing 2. The update routine is contained in lines 350–840.

Menu option 5, the print contents routine, provides a table of contents listing of the array A$. Outputs to the terminal are the batch number, type of wine and the current status of the process. This is done for each wine contained in the array, as shown in the example in the second part of Listing 2. Lines 850–900 contain this routine.

The print batch routine (menu option 6) provides a formatted listing of all of the data contained in the log about a wine. This routine, contained in lines 910–1370, allows creating a hard copy of the log for reference or other purposes.

When the operation of any of these routines is completed, the option menu is again re-entered, allowing a selection of another routine for the same or perhaps a different wine batch. The remaining statements, lines 1500–1550 and 2300–2360, are subroutines used by several of the menu routines.

**Conclusions**

The wine-log program has worked well, particularly in simplifying the recording of data. And the output is also nice. A completed wine log is shown in Listing 3 for a batch I have in progress. Some of the later comments in finishing the wine have been entered early to illustrate the completed wine log.

The result is a complete, legible record of the wine's growth from its initial mixing to its moment of presentation. Dionysus, Greek god of wine, would approve. ■

```
ENTER SPECIFIC GRAVITY
? 1.085

ENTER COMMENT
? FERMENT WELL UNDERWAY

IS THE WINE READY TO MOVE TO SECONDARY FERMENTOR (Y OR N)
? N


WINE-LOG OPTION MENU
SELECT OPTION:
   1 - LOAD WINE-LOG CASSETTE
   2 - SAVE WINE-LOG ON CASSETTE
   3 - CREATE NEW BATCH RECORD
   4 - UPDATE BATCH IN PROCESS
   5 - PRINT WINE-LOG CONTENTS
   6 - PRINT BATCH DETAIL
   7 - END PROGRAM
? 5

BATCH NUMBER   TYPE OF WINE    STATUS
    1          ZINFANDEL       PRIMARY FERMENT
    2          ROSE            SECONDARY FERMENT
    3          APRICOT         BOTTLE AGING
    4          ZINFANDEL       FINISHED
```

```
WINE-LOG FOR WINE BATCH #2
WINE STATUS: FINISHED
TYPE OF WINE          APRICOT
AMOUNT                5 GALS
YEAST STRAIN          ANDOVIN
DATE STARTED          2-12-80

INGREDIENTS USED:
BASE OR FRUIT TYPE         WINE-ART APRICOT BASE
AMOUNT OF WATER            21 QTS
AMOUNT OF SUGAR            13 LBS
CAMPDEN TABLETS            5 CRUSHED
YEAST NUTRIENT             1 OZ
GRAPE TANNIN               1/2 TSP
PECTIC ENZYME              2 1/2 TSPS
ACID BLEND                 2 OZ
OTHER INGREDIENTS          NONE

METHOD USED:
MIXED IN NORMAL FASHION ADDED
SUGAR S/T INITIAL S.G.=1.090
NET SUGAR ADDED = 13 LBS
INITIAL SPECIFIC GRAVITY   1.090
INITIAL ACID TEST          NOT DONE

TEST RESULTS WHILE IN PRIMARY FERMENTATION
TEST DATE  SPECIFIC GRAVITY    COMMENT
2-17-80         1.090          FERMENT START SLOW (COLD ROOM)
2-19-80         1.074          MOVED UPSTAIRS
2-20-80         1.068          ACTIVE FERMENTING NOW
2-23-80         1.040          LOOKING GOOD
2-24-80         1.030          RACKED TO SECONDARY

TEST RESULTS AT EACH RACKING
RACK DATE  SPECIFIC GRAVITY    COMMENT
3-24-80         NOT DONE       STRAINED AGAIN
                               AND COLOR LOOKS GOOD
6-2-80          NOT DONE       COMPLETELY CLEAR; FLAVOR GOOD
                               NEEDS SOME MORE FINISHING
9-2-80          NOT DONE       READY TO BOTTLE
                               ADDED FOR SLIGHTLY SWEET

THIS BATCH WAS BOTTLED ON 9-3-80
ITS FINAL CHARACTERISTICS WERE
BOUQUET              GOOD
FLAVOR               EXCELLENT
BODY                 MEDIUM
TANNIN
ACID                 GOOD
% ALCOHOL            UNKNOWN
DRY OR SWEET         JUST SLIGHTLY SWEET
```

*Listing 3. Sample wine log.*



Reader Service—see page 257

# Beat the Clock

*Clock fix for the Ithaca Intersystems Z-80 boards and other boards that use the 8224 clock generator.*

*Michael L. Simon*
*Space-Time Productions*
*2053 N. Sheffield*
*Chicago, IL 60614*

The clocks on CPU boards using the 8224 clock generator can be sluggish at high frequencies (36 MHz) or erratic at low frequencies (18 MHz). The oscillator is very sensitive to power supply voltage and impedance.

This problem has two possible solutions.

The simplest and cheapest is to install two capacitors from pin 9 of the 8224 to pin 8. The two capacitors are .01 and .001 disk ceramic. Both should be of the miniature variety, with the .01 rated at no more than 50 volts. Be sure to keep the leads as short as possible; as little as 1/16 of an inch can make a difference.

On boards where the 8224 drives TTL or a Z-80 directly, the voltage on pin 9 is reduced from 12 volts to 5 volts to make the clock output levels TTL compatible. The oscillator is therefore very sluggish. You can correct this by connecting pin 9 to a source of 12 volts through a limiting resistor.

Fig. 1 shows the two circuits I tried. In some cases you might need to reduce the resistor used in the zener diode circuit from 2.2k to 1k.

Some sluggish crystals seem to benefit by having the case connected to the nearest ground. This also makes the crystal more stable and less subject to mechanical vibration. ■

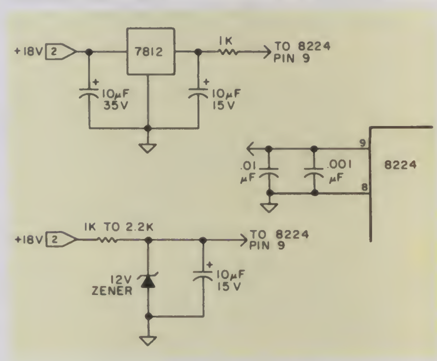



*Fig. 1. 8224 clock fix.*

# A Microcomputer Tea Party

*In its third year, the annual Personal Computer World Show is almost a tradition.*

*Jake Commander*
*305 Brownfied Road, Shard End*
*Birmingham, England B34 7EA*

*Personal Computer World* is an English magazine with the distinction of having been around longer than any other microcomputer magazine in that country. Once a year it blows its own trumpet, performing a service to the microcomputer industry as it does so. This year London hosted the third annual Personal Computer World Show. This makes it almost a tradition by microcomputer standards.

All the big names were there—and a few small ones too. Not surprisingly, the biggest exhibitor was Tandy, with a hands-on opportunity for anyone who wanted to try out a Model I TRS-80 for size. Ten machines and programs were provided for potential buyers, who kept the Model I machines busy. Also on view were the Models II and III, as well as its handheld computer. There was no missing this stand, as it was always full of people—something Tandy needs in the U.K. and Europe.

Commodore and Apple, despite being bigger sellers in Europe, didn't exhibit directly, but were represented by other manufacturers who sold software for those machines.

For those of you who haven't yet committed yourself to purchasing a microcomputer, then maybe the Sinclair stand would have been of interest. Sinclair featured their highly acclaimed ZX-80 microcomputer (Photo 1) and announced two new products. One was a high-level full facility 8K BASIC ROM, which replaces the 4K ROM in the standard microcomputer. The other has a 16K RAM upgrade that plugs neatly into the existing expansion port on the rear of the ZX-80 keyboard.


*Photo 1. Sinclair displayed its ZX-80 microcomputer at the Personal Computer World Show in London. A new 16K byte RAM pack can be attached via an edge connector at the rear of the computer.*

Newbury Labs in England displayed a new handheld computer called the NewBrain, which is more expensive than the Sharp handheld model but features such attractions as compiled BASIC, mains/battery operation, built-in video display and bidirectional analog interfaces. Watch out for this machine; it would appear the world of

microcomputers is only just beginning.

Remarkably similar to the Exatron Stringy Floppy was the Aculab Floppy Tape. This unit uses exactly the same wafers as the ESF, but the whole unit simulates disk operation. The wafer is formatted into sectors; filenames can be assigned extensions plus drive numbers; and directories can be obtained. The unit is definitely a poor man's disk drive. Any connection with Exatron was vehemently denied, despite the fact that all the commands begin with an "at" sign and the ROM is mapped to the same area of the TRS-80.

A novel input device from Oxford Computing Ltd. was the Datapad 1 digitizer (Photo 2). This pad is similar to an electronic clipboard that takes an A4 (8½ × 11 inches) sheet of paper. By using the Datapad pen, you can input points from the sheet to any computer—microcomputer, minicomputer or mainframe. Thus, all sorts of data, including low-resolution lines, dots or curves, normally entered onto paper can be entered without a keyboard. Oxford Computing suggests a number of interesting applications in dentistry, stock control and education to grade exam papers.

The PCW show was also the scene of a microcomputer chess championship, which was run over the three days of the exhibition and was open to both amateurs and professionals (Photo 3). This year the championship was held under the aegis of FIDE (the World Chess Federation) and the International Computer Chess Association. Even though this was the third consecutive year of micro chess competition, this was the first official World Microcomputer Chess Championship.

The first prize of five hundred pounds went to a version of the Fidelity Chess Challenger which is not yet commercially available, but no doubt will be soon. It uses a 6502 CPU with 20K of RAM (although nobody was saying how much ROM was used nor who programmed it. The name of Spracklen was bandied about and has not yet been denied). Second prize was shared between two amateur entries: Mike 3.0, a British entry from Mike Johnson using another 6502, and Rook 4.0, a Swedish entry from Lars Karlsson using a Z8000.

Thus, the 3rd Personal Computer World Show ended with the Z8000 16-bit microprocessor making a quiet, but nonetheless significant, mark in the world of micros. Could this be the first sign of an important step forward in microcomputing? ■

*Photo 2. The OCL Datapad I digitizer makes possible rapid data entry without a keyboard. It accommodates virtually any standard form up to A4 size.*


*Photo 3. The first World Microcomputer Chess Championship was won by the Fidelity Chess Challenger at the PCW show.*



✓Reader Service—see page 257

# Notes on the Arian Assembler

*Some pluses and minuses SuperSoft doesn't mention.*

*Bruce R. Evans, M.D.*
*16 Marwin Road*
*Pickering, Ontario*
*Canada L1V 2N7*


***The Arian assembler.***

I recently bought a North Star disk system but found that my ALS-8 assembler needed too many modifications to be compatible.

I was therefore pleased to discover the SuperSoft's Arian assembler, written specifically for the North Star system.

Arian does everything that an assembler should do, and does it well. But it has extras and failings that SuperSoft doesn't mention.

**Requirements**

The hardware requirements for Arian included an 8080-based microcomputer with a North Star minidisk system. The manual states that you must have memory from 00 hex to 2000 hex. This is only partially true: this is the amount of memory necessary to hold the assembler. You must have memory above this to hold the DOS, and memory from 3500 hex to at least 3FFF hex for the source programs and assembled object code to be stored.

This should be obvious to anyone used to an assembler, but it would be nice to see it spelled out. Failing to describe the obvious is one big oversight of the guidebook.

The assembler uses the North Star disk operating system (DOS) that is already in the machine. You must specify when ordering whether you have the single- or double-density version. This lets Arian access all the disk-related commands in the powerful North Star DOS. This is a big plus for this assembler.

**Features**

My manual arrived with two update notes telling me that I was also receiving Arian-2 on the diskette. This is supposed to be an improved program giving better support to the disk commands in the DOS. This version lets you select one of three drives, create new disk files and rename them. However, you lose the DEP and EXAM commands that let you examine and directly change memory. This makes it impossible to customize the software without leaving the program, since this customizing involves changing bytes within the program. Try doing that without a DEP command! The original Arian is still included, and unless otherwise stated, all my comments apply to both programs.

The documentation that accompanies the program is excellent by industry standards, but this is no recommendation. You should be familiar with assembly-language programming before tackling the manual. Naturally, no source code listing is included. When will software manufacturers realize that we customers are not all pirates, and that we would like to be able to modify our software?

One excellent innovation is the inclusion of a "keyboard session." You are instructed to enter a series of commands, create files and use all the features of the assembler. Since the only way to learn the Arian is to use it, this computer-assisted learning session is welcome. It also tests the accuracy of your copy of software.

There are drawbacks. For instance, I managed to mess up some data that I had on the second disk drive. The moral—don't leave diskettes in the drive if you are not using them.

**Operation**

The assembler uses the standard Intel mnemonics and pseudo-ops. I won't dwell on them—unfortunately, neither does the *manual*.

The most striking feature of Arian is the dynamic allocation of the source and object codes. When you create a file for the source code, the program automatically gives it a start address (3500 hex for the first file) and the end address. It then does the same for any of the other nine files that can be supported. However, the memory manager keeps track of the files, and if you are about to overwrite another file, the source code is moved to another location. This allows very economical program storage.

Later, when you assemble the source code, the program uses the last 2K of RAM to store it, unless you give another origin either in the file or in the assembly instructions. You don't even have to remember where the machine code is, since the EXEC command will automatically execute the current file and the disk commands will automatically act on the current file no matter where it is.

You can save a copy of the source code on disk for safekeeping and then debug the assembled program in a small area of memory. When it is debugged, it is a simple matter to save the new source file and assemble it at the final location. You will always be able to relocate your software as long as you have the source code on file on the disk. The program lets you keep as many source files as you wish on the disk; then when you read a file in, it becomes the new current file. The links with the DOS let you rename the file when you save it again after modifying it.

The EDIT command (or "intra-line editor," as SuperSoft prefers to call it) takes time getting used to. But so does every other editor that I have tried. I'll get used to it. A LISTN command lets you list the source file without line numbers. This lets you use Arian for word processing. But every assembler tries to do this. Have the creators ever looked at the Electric Pencil et al? They are outclassed!

Arian will not support macros, but this is not a problem for most programmers. Even so, all is not lost, since there is a library of subroutines that cover many situations where you would have to write your own subroutines. These are mainly I/O-related. Arian lets you insert breakpoints for debugging, but I would appreciate the inclusion of a simulator program, such as SIM-1, as well.

**Limitations**

I have run into a few small, but annoying, problems. First, the manual barely covers file naming, particularly the inclusion of a start address for the file. As I mentioned earlier, this is usually handled by the memory manager, but you have the option of putting them anywhere in memory. Because the length of file names was not discussed, I had particular problems with a file that I named BYTPROM2. After creating about six lines of code, the program invariably hung up.

Only after an embarrassing number of tries did I realize that the source file was being located at 0002 and destroying part of the assembler program itself. The assembler was using the last character of the file name as an address!

A second petty annoyance is the prompt character (>). Sometimes it will jump while awaiting input. No problem, but annoying. Sometimes, after a command is executed, it is necessary to push return before a prompt appears on the screen.

My final peeve is that any disk operations that run into a hard disk error cause the computer to jump back into the DOS rather than back to Arian. This is obviously due to the fact that the program jumps to and from the DOS for its I/O commands.

**Conclusions**

In summary, I find both Arian and Arian-2 to be excellent assemblers. They contain features that simplify assembly-language programming, and the disk commands are pure delight to a hacker used to a cassette-based system. The small annoyances are common in microcomputer software and are much less troublesome than usual. SuperSoft has two very useful assemblers, and with the few exceptions that I mentioned, you can be sure that they deliver all that they promise—and then some. ■

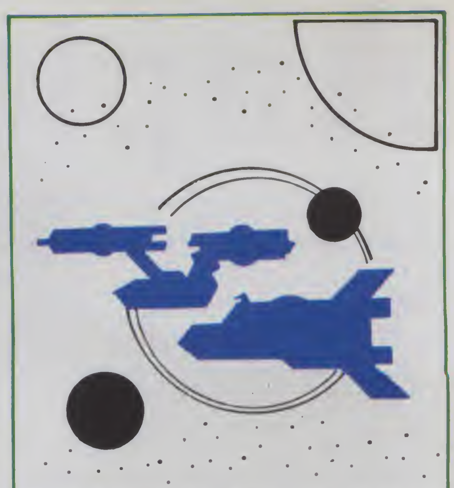
Reader Service—see page 257


**MORTGAGE WITH PREPAYMENT OPTION/FINANCIER** These two programs will more than pay for themselves if you mortgage a home or make investments:

•**Mortgage with Prepayment Option**—Calculate mortgage payment schedules and save money with prepayments.

•**Financier**—Calculate which investment will pay you the most, figure annual depreciation, and compute the cost of borrowing, *easily and quickly*.

All you need to become a financial wizard is an 8K PET. **Order No. 0006P $7.95.**



**TREK-X** Command the Enterprise as you scour the quadrant for enemy warships. This package not only has superb graphics, but also includes programming for optional sound effects. A one-player game for the PET 8K. **Order No. 0032P $7.95.**

**ACCOUNTING ASSISTANT** This package will help any businessman solve many of those day-to-day financial problems. Included are:

•**Loan Amortization Schedule**—This program will give you a complete breakdown of any loan or investment.

•**Depreciation Schedule**—You can get a depreciation schedule using any one of the following methods: straight line, sum of years-digits, declining balance, units of production, or machine hours.

This package requires the PET 8K. **Order No. 0048P $7.95.**

**ARCADE II** One challenging memory game and two fast-paced action games make this one package the whole family will enjoy for some time to come. Package includes:

•**UFO**—Catch the elusive UFO before it hits the ground!

•**Hit**—Better than a skeet shoot. The target remains stationary, but you're moving all over the place.

•**Blockade**—A two-player game that combines strategy and fast reflexes.

Requires an 8K PET. **Order No. 0045P $7.95.**

**TURF AND TARGET** Whether on the field or in the air, you'll have fun with the Turf and Target package. Included are:

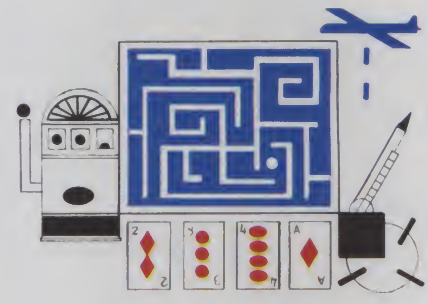
•**Quarterback**—You're the quarterback as you try to get the pigskin over the goal line. You can pass, punt, hand off, and see the result of your play with the PET's superb graphics.

•**Soccer II**—Play the fast-action game of soccer with four playing options. The computer can play itself or a single player; two can play with computer assistance; or two can play without help.

•**Shoot**—You're the hunter as you try to shoot the bird out of the air. The PET will keep score.

•**Target**—Use the numeric keypad to shoot your puck into the home position as fast as you can.

To run and score, all you'll need is a PET with 8K. **Order No. 0097P $7.95.**



**HOOPTEDOODLE**

This package is a collection of eight entertaining programs for you and your 8K PET. You'll escape from a monster in an unseen maze, try your luck with the one-armed bandits, cross a treacherous mine field, deflect the "bouncing ball", direct a low level bombing mission, maneuver a high-speed "worm" to score points, launch ground to air missiles, and play a challenging card game.

Having fun with this package is as easy as pressing PLAY on the Recorder.

**Order No. 0091P $9.95.**

Most of the programs in this catalog were written for the old ROM. They will run in the new ROM correctly if a few minor changes are made.

\# **0015P-CRAPS:** In line 96 insert a cursor control CLR ♥ after the quotation marks (") and before the text BYE, HAVE A NICE DAY!

\# **0022P-CHECKERS:** In line 1410 delete the ending semicolon (;). In line 236 delete the cursor control character after the first quote ("). Redo line 4020 so it reads 4020 PRINT:PRINT

**BACCARAT:** In lines 360 and 480 add a blank either before or after the text in quotes.

\# **0038P-QUBIC-4:** In all places where POKE 525 and WAIT 525 are used change them to POKE 158 and WAIT 158.

\# **0045P-UFO:** Line 1220 needs a semicolon (;) added to the end of it.

\# **0104P-DECORATOR'S ASSISTANT:** These POKEs should be changed; 519 to 249; 525 to 158; 526 to 159; 527 to 160.

\# **0112P-DECEITFUL MASTERMIND:** Add this line; 1675 PRINT

**TO ORDER:** Look for these programs at the dealer nearest you (see list on the next page). If your store doesn't stock Instant Software send your order with payment to: Instant Software, Order Dept., Peterborough, N.H. 03458 (Add $1.00 for handling) or call toll-free 1-800-258-5473 (VISA, MC and AMEX accepted).

**Instant Software™**

Prices subject to change without notice.

PETERBOROUGH, N.H. 03458
603-924-7296

## Finance and Investment

Attention all would-be millionaires. Now, keep track of your investments by harnessing the power of your Apple II (or Apple II Plus) with the speed of floppy disk storage. The Finance and Investment package has been fashioned to help you, the businessman, to solve some of those time-consuming tasks you face daily. The programs included are:

**Loan Amortization Schedule**—This program will calculate a complete monthly breakdown of any loan or investment. All you do is enter the amount of the principal, the interest rate, the term of the loan or investment and the number of payments per year. You'll see a month-by-month list of the principal, interest, total amount paid and the remaining balance. Any of the amounts can be listed on a paid-to-date basis, at your option.

**Depreciation Schedule**—It will compute a depreciation schedule using any one of the following methods: Straight Line, Sum of Years-Digits, Declining Balance, Units of Production or Machine Hours. Just enter data in response to the computer's prompts and you'll see a list of how long the item has been or will be in use, the annual depreciation, the accumulated depreciation and the remaining book value.

**Mortgage with Prepayment**—Use this program to develop a prepayment plan that will provide optimum savings on the cost of the mortgage, reduce the terms of the mortgage and help avoid overtaxing your income in the process. It will calculate the cost of the original mortgage, as well as the cost and savings on a mortgage with annual prepayments. If you must borrow money to make the prepayments, the computer takes the added interest into consideration.

**Financier**—This program is designed to take the extensive paperwork out of your daily financial planning. It performs ten common financial calculations that can help you: (1) design optimum investment schedules; (2) check on depreciation rates, amounts and resale values; and (3) let you know exactly what a given loan is going to cost in terms of time *and money*.

Minimum system requirements are an Apple II or Apple II Plus with 32K of memory, one mini-disk drive and Applesoft BASIC.

**Order No. 0162AD $19.95**


## Skybombers II

Two countries, separated by The Big Green Mountain, are at war. Both nations are equipped with only one means of attack—SKYBOMBERS!

You and your opponent, each representing the nations at war, command opposing fleets of fighter-bombers armed with bombs and missiles. As enemy commanders, each of you has specific orders: Fly across that mountain and bomb the enemy blockhouse into oblivion!

Flying over that innocent looking mountain is not easy for either air force. The aircraft can fire missiles at each other; if that fails, they can ram each other. Sometimes, aircraft encounter falling bombs and are blown to pieces in flight. Desperate pilots can even crash into the enemy blockhouse.

Flight personnel are sometimes forced to parachute from badly damaged aircraft. As they float slowly to earth, they become helpless targets for the enemy to destroy in mid-air.

The sounds of battle, from exploding bombs to the screams from wounded parachutists being attacked, are there to remind each commander of his grim responsibility.

Explosions are graphically displayed for both commanders. The scores for both countries are constantly updated at the bottom of the display screen.

Flying these missions develops into a gripping fascination. Air warfare becomes a vivid reality, as you both play the deadly game of Skybombers II.

The Skybombers II program requires 32K RAM, one disk drive, Applesoft in ROM and the game paddles.

**Order No. 0271AD (disk-based version) $19.95.**

**WRITE FOR OUR NEW CATALOG!**

## OTHER PROGRAMS FROM INSTANT SOFTWARE

### TRS-80* LEVEL I & II

| | | |
|---|---|---|
| 0001R | Basic and Intermediate Lunar Lander | $7.95 |
| 0002R | Space Trek II | $7.95 |
| 0004R | Beginner's Backgammon/Keno | $7.95 |
| 0007R | Ham Package I | $7.95 |
| 0008R | Electronics I | $7.95 |
| 0009R | Golf/Cross-Out | $7.95 |
| 0017R | Air Flight Simulation | $7.95 |
| 0019R | Business Package IV | $9.95 |
| 0023R | Oil Tycoon | $7.95 |
| 0033R | Bowling | $7.95 |
| 0043R | Santa Paravia and Fiumaccio | $7.95 |
| 0046R | Othello | $9.95 |
| 0050R | Grade Book | $9.95 |
| 0057R | Chessmate-80 | $19.95 |
| 0099R | Typing Teacher | $9.95 |

### TRS-80* LEVEL II

| | | |
|---|---|---|
| 0028R | Ramrom Patrol/Tie Figher/Klingon Capture | $7.95 |
| 0034R | Space Trek IV | $7.95 |
| 0047R | Who-Dun-It? | $7.95 |
| 0049R | Demo II | $7.95 |
| 0051R | Ball Turret Gunner | $9.95 |
| 0055R | Demo III | $7.95 |
| 0056R | Bowling League Statistics System | $24.95 |
| 0058R | Programmer's Converter | $9.95 |
| 0063R | Cards | $7.95 |
| 0065R | Teacher | $9.95 |
| 0066R | Mimic | $7.95 |
| 0068R | Your Cribbage and Checkers Partner | $9.95 |
| 0069R | Household Accountant | $7.95 |
| 0070R | Skirmish-80 | $9.95 |
| 0072R | Financial Assistant | $7.95 |
| 0076R | TRS-80* Utility II | $7.95 |
| 0077R | Enhanced BASIC | $24.95 |
| 0081R | TRS-80* Utility I | $7.95 |
| 0082R | Daredevil | $9.95 |
| 0084R | Music Master | $7.95 |
| 0089R | Energy Audit | $49.95 |
| 0092R | Archimede's Apprentice | $9.95 |
| 0100R | Video Speed-Reading Trainer | $9.95 |
| 0103R | Personal Bill Paying | $7.95 |
| 0106R | Airmail Pilot | $7.95 |
| 0109R | Body Buddy | $9.95 |
| 0111R | Wordwatch | $7.95 |
| 0117R | Night Flight | $9.95 |
| 0118R | Mind Warp | $9.95 |
| 0124R | Winner's Delight | $9.95 |
| 0125R | Investor's Paradise | $9.95 |
| 0126R | The Communicator | $9.95 |
| 0127R | Surveyor's Apprentice | $9.95 |
| 0129R | The Wordslinger | $29.95 |
| 0130R | Terminal-80 | $39.95 |
| 0131R | Sales Analysis | $24.95 |
| 0132R | Energy Consumption | $9.95 |
| 0135R | Executive Expense Report Generator | $9.95 |
| 0136R | Beginner's Russian | $9.95 |
| 0137R | Everyday Russian | $9.95 |
| 0140R | Oracle-80 | $75.00 |
| 0141R | Battleground | $9.95 |
| 0156R | Money Madness | $9.95 |
| 0157R | IQ Test | $9.95 |
| 0159R | Jet Fighter Pilot | $14.95 |
| 0171R | Flight Path | $9.95 |
| 0203R | BASIC Programming Assistant | $14.95 |
| 0223R | Cosmic Patrol | $14.95 |
| 0230R | TLDIS | $14.95 |
| 0232R | The Disassembler | $9.95 |
| 0250R | IRV | $24.95 |
| 5002R | Basic Math Program from EMSI | $80.00 |

### TRS-80* DISKS

| | | |
|---|---|---|
| 0052RD | Energy Audit | $75.00 |
| 0075RD | Accounts Payable/Receivable | $199.95 |
| 0095RD | Bowling League Secretary | $49.95 |
| 0123RD | The One-D Mailing List | $24.95 |
| 0139RD | Disk-Scope | $19.95 |
| 0147RD | Check Management System | $39.95 |
| 0151RD | QSL Manager | $19.95 |
| 0152RD | Oracle-80 | $99.95 |
| 0180RD | Disk Editor | $39.95 |
| 0212RD | The Russian Disk | $24.95 |
| 0214RD | Teacher's Aide | $39.95 |
| 0231RD | DLDIS | $19.95 |
| 5000RD | Mail List from Galactic (Mod. I) | $99.00 |
| 5001RD | Mail List from Galactic (Mod. II) | $199.00 |

### PET**

| | | |
|---|---|---|
| 0005P | Personal Weight Control/Biorhythms | $7.95 |
| 0006P | Mortgage w/Prepayment Option/Financier | $7.95 |
| 0014P | Casino I | $7.95 |
| 0015P | Casino II | $7.95 |
| 0026P | Dow Jone$ | $7.95 |
| 0029P | Tangle/Supertrap | $7.95 |
| 0032P | Trek-X | $7.95 |
| 0035P | PET Demo I | $7.95 |
| 0038P | Qubic-4/Go-Moku | $7.95 |
| 0039P | Mimic | $7.95 |
| 0044P | Penny Arcade | $7.95 |
| 0045P | Arcade II | $7.95 |
| 0048P | Accounting Assistant | $7.95 |
| 0054P | Ham Package I | $7.95 |
| 0062P | Baseball Manager | $14.95 |
| 0064P | Dungeon of Death | $7.95 |
| 0074P | Arcade I | $7.95 |
| 0083P | Digital Clock | $7.95 |
| 0085P | Electronics Engineer's Assistant | $9.95 |
| 0091P | Hooptedoodle | $9.95 |
| 0097P | Turf and Target | $7.95 |
| 0104P | Decorator's Assistant | $7.95 |
| 0105P | PET Utility I | $9.95 |
| 0110P | Chimera | $7.95 |
| 0112P | Code Name: Cipher | $7.95 |
| 0175P | Santa Paravia and Fiumaccio | $9.95 |

### APPLE***

| | | |
|---|---|---|
| 0018A | Golf | $7.95 |
| 0025A | Mimic | $7.95 |
| 0040A | Bowling/Trilogy | $7.95 |
| 0073A | Math Tutor I | $7.95 |
| 0079A | Oil Tycoon | $9.95 |
| 0080A | Sahara Warriors | $7.95 |
| 0088A | Accounting Assistant | $7.95 |
| 0094A | Mortgage w/Prepayment Option/Financier | $7.95 |
| 0096A | Space Wars | $7.95 |
| 0098A | Math Tutor II | $7.95 |
| 0148A | Air Flight Simulation | $9.95 |
| 0174A | Santa Paravia and Fiumaccio | $9.95 |

### APPLE***

| | | |
|---|---|---|
| 0160AD | Math Fun | $19.95 |
| 0161AD | Apple Fun | $19.95 |
| 0162AD | Finance and Investment | $19.95 |
| 0163AD | Paddle Fun | $19.95 |

### HEATH****

| | | |
|---|---|---|
| 0087H | Mental Gymnastics | $7.95 |

*A trademark of Tandy Corporation
**A trademark of Commodore Business Machines
***A trademark of Apple Computer Inc.
****A trademark of HEATH Company

# Instant Software™

Prices subject to change without notice.

PETERBOROUGH, N.H. 03458
603-924-7296

✓40

# Speech Synthesis For the 6800

*Give your SWTP the gift of gab for uses ranging from computer-aided instruction to audible I/O for the handicapped.*

*Terry L. Mayhugh*
*11632 Midhurst Drive*
*Concord, TN 37922*

A speech synthesizer is one of the most exciting peripherals that a hobbyist can add to a home computer system. Computerized speech synthesis opens the door to an almost unlimited number of new uses for a micro, ranging from preschool computer-aided instruction to audible I/O for blind users.

Until recently, genuine speech synthesis equipment was not only difficult to find, but far beyond the budget of the average experimenter. However, researchers from the Votrax Division of the Federal Screw Works have produced a scaled-down version of one of their more expensive units. Designed specifically to interface to the TRS-80 through its expansion connector, the unit is marketed by Radio Shack and distributed through their many dealers.

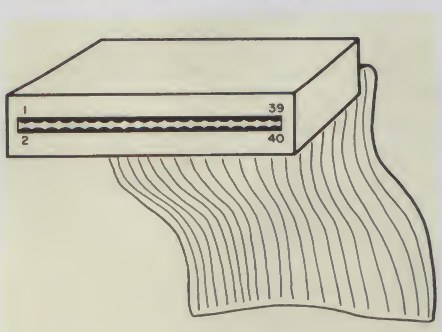


*Fig. 1. Votrax ribbon cable connector.*

Fortunately, due to its simple parallel interface requirements, it can be easily interfaced to practically any computer. Hardware enthusiasts can connect it to any eight-bit parallel port. This article includes details for an interface to an MPLA card in an SWTP 6800 computer.

### Synthesis by Rule

The Votrax device uses a "synthesis by rule" technique of voicing words by synthesizing individual units of speech called phonemes. With suitable software, the phonemes are sequentially output to the synthesizer to produce intelligible speech.

Such an approach, in contrast to the ROMed vocabulary techniques of other units, such as TI's Speak and Spell module, allows unlimited vocabulary production in any language. This particular model is capable of producing 62 different phonemes, which, if properly sequenced, can produce nearly any word in the English language with reasonable clarity. Synthesis of many foreign words and phrases is also possible.

The Votrax hardware does most of the work, and so you need little overhead in the way of computer memory or software. In fact, voicing words through BASIC can be as simple as outputting their phonetic spellings using simple PRINT statements.

The input of the synthesizing unit contains a character FIFO buffer, which has been memory-mapped into the last 32 locations of the TRS-80 video display refresh memory. Phoneme characters shifted into this buffer from the computer determine the specific sounds that the unit voices. The synthesizer takes care of processing the characters in the buffer at the proper rate until it is empty. Table 1 lists the complete Votrax phoneme character set, along with the corresponding ASCII equivalent character set.

You will notice that some of the vowel phonemes have several listings such as EH1, EH2, EH3. This is to allow for various durations (40 to 160 ms), in this case, of the "ea" sound. The longer duration vowel (EH1) is normally used in monosyllabic words or as the stressed syllable of longer words. Phonetic groups, such as stop plosives, fricatives, nasals and semivowels, and their uses are discussed in a manual that comes with the synthesizer. Also included are several examples of phonetic programming in BASIC.

### Interfacing the Synthesizer

The Votrax synthesizer operates from 110 V ac and comes assembled in its own cabinet. Computer interfacing to the unit is accomplished through a 40-pin edge card connector on the end of a two-foot ribbon cable. Connection to the synthesizer is most easily done by soldering the computer connections to a piece of suitably cut PC edge card stock from the junk box. The PC board is then slid into the connector as it was intended to be used.

As shown in Fig. 1, the Votrax connector

| Votrax Character | ASCII Equivalent | Key Word | | | |
|---|---|---|---|---|---|
| THV | < | the - smooth - mother | 001 | % | took - put - good |
| TH | = | thing - math | Y | & | yard - berry |
| SH | > | sheep - fish - action | U | ' | move - school - June |
| WINDOW | ? | (toggle synthesizer) | IU | ( | you - music |
| A1 | @ | tame - pail - make | A2 | ) | tame - pail - make |
| AH2 | A | tame - pail - make | AY | * | jade - made - claim |
| B | B | bat - rub | NG | + | ring - drink - shingle |
| CH | C | cheese - march - match | AW | , | call - paw |
| D | D | dad - raid | 0 DEC. | - | (background noise silencer) |
| E1 | E | beef - be - even | E | . | beef - be - even |
| F | F | fake - cuff - phone | ER | / | third - heard - churn - over |
| G | G | get - log | PA0 | 0 | (pause character) |
| H | H | hoop - have | AW1 | 1 | call - paw |
| I1 | I | pit - in | AW2 | 2 | call - paw |
| J | J | job - jazz | EH1 | 3 | ready - leg |
| K | K | kill - kick | EH2 | 4 | ready - leg |
| L | L | low - late | EH3 | 5 | ready - leg |
| M | M | mat - dim | UH1 | 6 | around - undone - friction |
| N | N | no - son | UH2 | 7 | around - undone - friction |
| O1 | O | for - torn - bold | UH3 | 8 | around - undone - friction |
| P | P | pack - flap - happy | AE1 | 9 | dad - plaid |
| DT | Q | butter | AE | : | dad - plaid |
| R | R | race - hard - hair | AH1 | ; | honest |
| S | S | soup - ask - pass - city | W | W | wake - always - when |
| T | T | tip - pat - asked | ZH | X | pleasure - azure |
| U1 | U | move - school - June | Y1 | Y | you - music |
| V | V | van - pave | Z | Z | zap - haze - pans |
| PA1 | SPACE | (pause character) | 02 | [ | for - torn - bold |
| I2 | ! | pit - in | 0 | \ | for - torn - bold |
| I | " | pit - in | AH | ] | mop - blotter |
| I3 | # | pit - in | A | ↑ | tame - pail - make |
| 00 | $ | took - put - good | NULL | _ | |

*Table 1. Votrax character set.*

pins are numbered from left to right, with the odd-numbered pins on the top and the even-numbered pins on the bottom. These numbers do not correspond to those of the TRS-80 expansion connector edge card. The numbers referred to in this article are those of the Votrax connector.

Table 2 shows the pin assignments grouped according to function, along with a parallel port assignment for an MPLA card in an SWTP 6800 computer. In this assignment the synthesizer is interfaced to the A side (configured for computer output) of the 6820/21 PIA. Tying the Votrax address bits 5 through 13 high and bits 14 and 15 low correctly addresses the synthesizer so that it can accept data bytes from the PIA. Data is strobed into the FIFO of the synthesizer on the positive edge of a WRITE pulse (500 ns minimum), which must occur after each byte is loaded into the PIA data register. The CA2 line is used for this purpose.

The assembled listing in Listing 1 is a suitable driver routine that properly configures an MPLA card in slot 3. Phonemes may be sent to the *synthesizer* by loading the data register of the PIA with the appropriate ASCII equivalents, using simple LDA and STA instructions. This driver may be used alone or called within a BASIC interpreter, using the CALL or USER commands.

If you are using Computerware's random disk BASIC (BBAS version 9D), you may output phonemes directly with PRINT statements (i.e., PRINT #3 if using slot 3) by poking locations $0218 and $0219 within the interpreter with NOPs at the beginning of your program. This bypasses the normal handshaking and prevents the computer from getting into an endless loop while waiting for an acknowledge signal from the synthesizer. (POKE locations $0227 and $0228 with NOPs in Smoke Signal's BASIC version 5.9.)

Because Radio Shack chose not to include any handshaking with the synthesizer, you must not output too many characters in succession or the 32 character buffer might overflow and cause data loss. Since the phonemes last from 40 to 160 ms, a full buffer may take from one to five seconds to empty. This is best handled experimentally by inserting software delays between

| Function | Votrax Pin # | MPLA Assignment |
|---|---|---|
| WRITE | 27 | CA2 |
| DATA BIT 0 | 12 | A0 |
| DATA BIT 1 | 20 | A1 |
| DATA BIT 2 | 10 | A2 |
| DATA BIT 3 | 16 | A3 |
| DATA BIT 4 | 24 | A4 |
| DATA BIT 5 | 14 | A5 |
| DATA BIT 6 | 18 | A6 |
| DATA BIT 7 | 22 | A7 |
| ADR BIT 5 | 5 | +5* |
| ADR BIT 6 | 4 | +5* |
| ADR BIT 7 | 6 | +5* |
| ADR BIT 8 | 29 | +5* |
| ADR BIT 9 | 23 | +5* |
| ADR BIT 10 | 38 | +5* |
| ADR BIT 11 | 31 | +5* |
| ADR BIT 12 | 35 | +5* |
| ADR BIT 13 | 36 | +5* |
| ADR BIT 14 | 32 | GND |
| ADR BIT 15 | 33 | GND |
| GROUND | 34 | GND |

*lines should be pulled high through 1k ohm resistors

*Table 2. Pin assignments for Votrax connector.*

```
                *   Votrax Speech Synthesizer Software Driver for SWTP MPLA Card

0100                    ORG    $0100
800C            PIA1AD EQU    $800C         Parallel interface in slot 3

                *   Port Initialization Subroutine
0100 CE 800C    IOINIT LDX    #PIA1AD
0103 6F 01             CLR    1,X
0105 6F 00             CLR    0,X
0107 63 00             COM    0,X           set 8 output lines on A-side of PIA
0109 86 3E             LDA A #$3E
010B A7 01             STA A 1,X            configure CA2 line operation
010D 39                RTS

                *   Character Output Subroutine (char assumed to be in accum A)

010E B7 800C    OUTPIA STA A PIA1AD         put character in data register
0111 C6 36             LDA B #$36
0113 F7 800D           STA B PIA1AD+1       take CA2 line (strobe) low
0116 C6 3E             LDA B #$3E
0118 F7 800D           STA B PIA1AD+1       take CA2 line back high
011B 39                RTS
                       END
```

*Listing 1. 6800 assembly-language software driver for the synthesizer.*

```
10 PRINT "ENTER ASCII EQUIVALENT OF PHONEME";
20 INPUT P$
30 PRINT #3, "?"; P$; "?";
40 GOTO 10
```

*Listing 2. Phoneme program in Smoke Signal BASIC.*

```
1000 FOR X = 1 TO LEN (K$)
1010 PRINT #3, ASC (MID$(K$,X,1))
1020 NEXT X
1030 RETURN
```

*Listing 3. Subroutine to output phonetic string K$.*

words or phrases as required to prevent over-spill. Simple FOR-NEXT delay loops may be used in BASIC.

**Using the Synthesizer**

The easiest way to use the synthesizer is to install a suitable driver routine, such as the one in Listing 1, and then communicate with the unit in BASIC. The synthesizer is toggled on and off by outputting a "?". An LED on the front of the unit indicates when it has been toggled on. After toggling the unit on, it is important to first send a pause phoneme (space), which synchronizes the synthesizer after it has been idle. Since the unit does not have a suitable power-on reset, this may also have to be done to keep it from jabbering when power is first applied.

Because the synthesizer continually voices the last phoneme residing in its buffer, you should also transmit a final pause at the end of each data block to silence it.

A simple program recommended by Radio Shack (and converted here to Smoke Signal BASIC) to familiarize the user with some of the phonemes the unit is capable of producing is shown in Listing 2. The subroutine in Listing 3 may be used to output the phonetic string K$.

This program pulls phonemes one at a time from the phonetic string K$ and sends them to the synthesizer. For example, to output the word "ready," K$ is set equal to "R35D8" by a previous statement. ■

# The Ackerman Digital Systems Noisemaker

*When it comes to making noise, you North Star users are no longer in the silent minority.*

*Steve Leibson*
*4405 Flattop Court #S-11*
*Fort Collins, CO 80525*

I admit it. I like to play games on my North Star computer. It was not purchased for that reason, but it's a lot of fun.

My friends who own Apples have long had noisy games such as Star Wars to play with. I have had to content myself with the silent classics such as Othello and Star Trek. But not anymore.

Ackerman Digital Systems (110 North York Road, Suite 208, Elmhurst, IL 60126) is marketing a board for S-100 systems called the Noisemaker. My North Star can now produce the shriek of phasor fire or the whoosh of my broadsword as I cleave through a greasy little dwarf.

### Hardware

The Noisemaker board is based on the General Instrument AY-3-8910 programmable sound generator. This integrated circuit has three tone generators, a noise generator, a mixer to combine those four sound sources and an envelope generator/programmable volume control to modulate sound intensity. Fig. 1 shows how these elements are arranged on the chip. The Noisemaker has two AY-3-8910s for stereo sound.

In addition, General Instrument has added two eight-bit parallel I/O ports to each chip. They may be programmed for either input or output. With two chips on board, the Noisemaker has 32 bits of I/O for adding control keys, Atari joysticks and other peripherals.

The Ackerman Digital Systems (ADS) Noisemaker board is a well-made double-sided board with plated-through holes. It is offered as a bare board only. I purchased the integrated circuits needed to assemble the Noisemaker from Advanced Computer Products, Inc., PO Box 17329, Irvine, CA 92705.

The assembly instructions are brief: You place all the parts on the board and solder. Fortunately, the board's silkscreen is excellent, and the parts are well-placed. Photo 1 shows the completed Noisemaker board. Audio and digital I/O signals are brought out on two 16-pin IC sockets in the upper right corner of the board.

The AY-3-8910 was not designed to interface to the 8080 or Z-80 processors. It requires longer pulses on the control lines than the S-100 bus normally supplies. ADS has added a wait state circuit on the latest revision of the Noisemaker to stretch the signals in time, thus meeting the sound generator's requirements. The wait is selectable and zero. One or two states may be chosen; my North Star requires one.

The wait is only activated when the processor accesses the Noisemaker. System performance is not noticeably degraded, since sound changes slowly with relation to processor execution speeds. The Noisemaker is only accessed to change, start or stop the sound synthesis.

Audio output is through two LM386 amplifiers, one for each sound generator chip. These amplifiers are powerful enough to drive a pair of EPI Microtower speakers, which used to be part of my stereo system. The maximum sound level is plenty, and there should be no need for additional amplification.

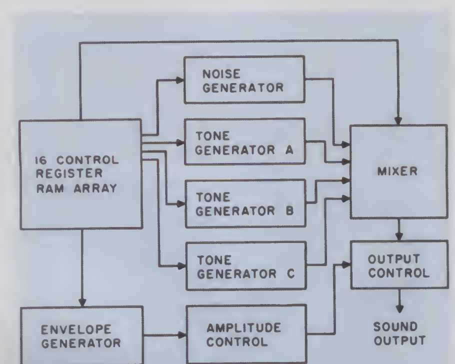



*Fig. 1. General Instrument AY-3-8910 programmable sound generator block diagram.*

The Noisemaker uses input/output (I/O) addresses as implemented in the Intel 8080 and the Zilog Z-80 processors. The I/O address space is separate from the memory space, and has only 256 locations. This address space is accessed with the machine code instructions OUT and INP. Many BASICs provide statements that perform these same operations to circumvent machine-language routines.

The AY-3-8910 appears to the processor as two I/O locations. I have set my Noisemaker to the highest I/O addresses so that the first sound generator chip is at locations 252 and 253 and the second one is at locations 254 and 255. While my North Star had no devices at those locations, yours may differ.

The lower-numbered address for each chip accesses a pointer register. This is used to point to one of the 16 control registers used to make sounds. The higher-numbered address for each chip is used to access these 16 registers after the pointer register has been set.

Fig. 2 illustrates the array of 16 registers used to program the sounds on the Noisemaker. Remember that there are two banks of these registers on the board, one in each AY-3-8910.

Clearly the complexity of the sound generator chips calls for extensive software. One or two simple register accesses won't produce sound from the Noisemaker. ADS has Introduced their Soundwriter software package for the Noisemaker hardware.

### Controlling the Noisemaker from BASIC

BASIC can be used to control the Noisemaker board for all but the most rapidly changing sounds. North Star BASIC, as well as many other BASICs, has OUT and INP statements that perform the 8080 OUT and INP operations.

The first six registers program the tone pitch for the three tone generators (A, B, C).

Each has two tuning registers. The first register for each generator is the eight-bit fine-tune register and the second is four bits for coarse tuning.

I prefer to think of these register pairs as 12-bit tone registers split to fit into eight-bit register pairs. The fine-tune register holds the eight least significant bits of the tone period, and the coarse register holds the four most significant bits. The sound generator chip combines the two registers to form a 12-bit tone period.

Unfortunately, General Instrument does not state what the upper bits in the coarse-tuning registers do. It is best to always leave them set to zero, along with all of the other unspecified bits in the noise period, amplitude and envelope shape/cycle registers.

The 12-bit value placed in the tone register specifies a tone period. Thus, the smallest value, one, is the smallest period or the highest frequency. The largest value, 4095, is the longest period and the lowest frequency.

The actual tone frequency is calculated using a simple equation. First, the input clock frequency is divided by 16. On my North Star, that input frequency is 2 MHz. This divided by 16 equals 125 KHz, or 125,000 cycles per second.

To obtain the actual tone frequency, you further divide the 125,000 Hz by the value of the tone period. If the tone period is set to a 1 (coarse = 0, fine = 1), then the tone frequency is 125,000 Hz. If the tone period is set to 4095 (coarse = 15, fine = 255), the tone frequency will be about 30.5 Hz. The tone generators have a very wide range.

Music will be one of the Noisemaker's applications. It would be tedious to calculate the register values for each note of the music scale. The computer is much better at performing such a tedious task. Listing 1 is a program for calculating those values.

Program line 1050 asks for the clock frequency your system supplies the Noisemaker. This might be 1 or 2 MHz, or some intermediate frequency such as 1.79 MHz. Enter the frequency as a number between zero and ten in MHz. Line 1060 multiplies this number by one million to get to the actual frequency.

You must accurately specify the frequency to obtain correct pitch. If the system clock is exactly 1.00000 or 2.00000 MHz, a 1 or a 2 response is adequate. If an unusual frequency, such as a 3.579545 MHz from a TV color-burst crystal, is the system frequency, the response to the frequency question in the program should be answered with the exact frequency.

If the frequency is not exactly specified, the pitches will all be transposed. Although they will be related to each other in the correct frequency ratios, they will not sound quite right.

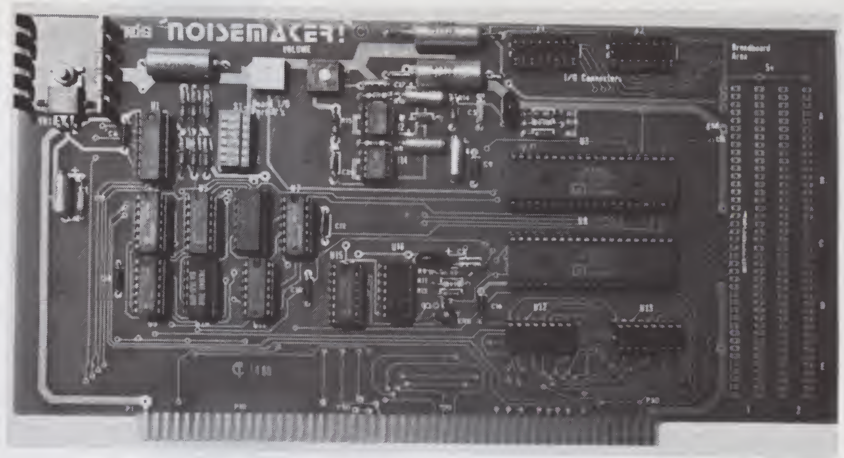



*Photo 1. Ackerman Digital Systems' Noisemaker board.*

Lines 1120 through 1150 calculate the tone period closest to the desired frequency obtained from the data list through the read statement. Since the 12-bit tone period is set in discrete steps between one and 4095, you won't get exact frequencies. Line 1130 calculates the tone period by taking the integer part of the input frequency divided by the desired frequency and 16. This is just the frequency calculation turned around a little.

Lines 1140 and 1150 check to see if the periods just above and below the calculated one might be closer to the desired frequency. By the time the program reaches line 1160, the tone period has been chosen.

The 12-bit tone period must be further broken down into the coarse and fine values for the corresponding registers. Line 1170 calculates the coarse value by dividing the tone period by 256 and taking the integer part. That will leave only the four most significant bits of the 12-bit tone period.

The fine value is obtained on line 1190 by multiplying the coarse value by 256 and subtracting it from the 12-bit tone period. Line 1210 prints the desired frequency and the actual frequency, and then the tone period and the coarse and fine values as integers.

The "%12F3" designator specifies a 12-character field in which a number is to be printed with three places after the decimal point. This format is for frequencies. The "%8I" specifies an eight-character field in which an integer is to be printed. Register values are integers. These specifiers are part of the North-Star-BASIC-formatted printing and make the printout look nice. If your BASIC does not support formatted prints, leave the specifiers out; it won't affect the numbers.

The data statements on lines 1240 through 1360 contain the frequencies for the equitempered musical scale. You can use other desired frequencies as well.

<table>
<tr><th colspan="2">REGISTER</th><th rowspan="2">FUNCTION</th><th rowspan="2">BIT 7</th><th rowspan="2">BIT 6</th><th rowspan="2">BIT 5</th><th rowspan="2">BIT 4</th><th rowspan="2">BIT 3</th><th rowspan="2">BIT 2</th><th rowspan="2">BIT 1</th><th rowspan="2">BIT 0</th></tr>
<tr><th>DECIMAL</th><th>OCTAL</th></tr>
<tr><td>0</td><td>0</td><td rowspan="2">CHANNEL A TONE PERIOD</td><td colspan="8">8-BIT FINE TUNE A</td></tr>
<tr><td>1</td><td>1</td><td colspan="4"></td><td colspan="4">4-BIT COARSE TUNE A</td></tr>
<tr><td>2</td><td>2</td><td rowspan="2">CHANNEL B TONE PERIOD</td><td colspan="8">8-BIT FINE TUNE B</td></tr>
<tr><td>3</td><td>3</td><td colspan="4"></td><td colspan="4">4-BIT COARSE TUNE B</td></tr>
<tr><td>4</td><td>4</td><td rowspan="2">CHANNEL C TONE PERIOD</td><td colspan="8">8-BIT FINE TUNE C</td></tr>
<tr><td>5</td><td>5</td><td colspan="4"></td><td colspan="4">4-BIT COARSE TUNE C</td></tr>
<tr><td>6</td><td>6</td><td>NOISE PERIOD</td><td colspan="3"></td><td colspan="5">5-BIT PERIOD CONTROL</td></tr>
<tr><td rowspan="2">7</td><td rowspan="2">7</td><td rowspan="2">$\overline{\text{ENABLE}}$</td><td colspan="2">$\overline{\text{IN}}$/OUT</td><td colspan="3">$\overline{\text{NOISE}}$</td><td colspan="3">$\overline{\text{TONE}}$</td></tr>
<tr><td>IOB</td><td>IOA</td><td>C</td><td>B</td><td>A</td><td>C</td><td>B</td><td>A</td></tr>
<tr><td>8</td><td>10</td><td>A AMPLITUDE</td><td colspan="3"></td><td>MODE</td><td colspan="4">4-BIT AMPLITUDE</td></tr>
<tr><td>9</td><td>11</td><td>B AMPLITUDE</td><td colspan="3"></td><td>MODE</td><td colspan="4">4-BIT AMPLITUDE</td></tr>
<tr><td>10</td><td>12</td><td>C AMPLITUDE</td><td colspan="3"></td><td>MODE</td><td colspan="4">4-BIT AMPLITUDE</td></tr>
<tr><td>11</td><td>13</td><td rowspan="2">ENVELOPE PERIOD</td><td colspan="8">8-BIT FINE TUNE ENVELOPE PERIOD</td></tr>
<tr><td>12</td><td>14</td><td colspan="8">8-BIT COARSE TUNE ENVELOPE PERIOD</td></tr>
<tr><td>13</td><td>15</td><td>ENV SHAPE/CYCLE</td><td colspan="4"></td><td>CONT</td><td>ATT</td><td>ALT</td><td>HOLD</td></tr>
<tr><td>14</td><td>16</td><td>I/O PORT A</td><td colspan="8">8-BIT PARALLEL I/O PORT A</td></tr>
<tr><td>15</td><td>17</td><td>I/O PORT B</td><td colspan="8">8-BIT PARALLEL I/O PORT B</td></tr>
</table>

*Fig. 2. Control register array.*

You may think that after all the work necessary to calculate the tone period, you can simply plug that value into the tone registers and listen. The AY-3-8910 is much more complex than that. You must still enable the tone generators through the mixer and set the volume.

Refer once again to Fig. 2 and note register 7. The three least significant bits are labeled $\overline{\text{TONE}}$. These are the tone generator enable bits. They specify which tone generators will be output.

To enable the A generator only, a 62 (00111110 in binary) must be placed in register 7. The enable bits are inverted so a zero in the enable bit enables the tone and a one disables it. Looking carefully at register 7 in Fig. 2, you'll see that the $\overline{\text{TONE}}$ enable bit for generator A is the least significant bit. Since you want to enable that bit, make it a zero.

All other sound sources are to remain disabled, so the rest of the $\overline{\text{TONE}}$ bits and all the $\overline{\text{NOISE}}$ bits will be ones. The I/O bits are zero, to leave the I/O ports as inputs. Thus, you get the binary value 00111110, which is 3E in hex and 62 in decimal.

Volume is set by a value in register 8 (10 octal). Full volume is 15 and silence is zero. Register 8 is only the volume control for generator A. Registers 9 and 10 (11 and 12 octal) set the volumes for generators B and C.

The ADS and General Instrument documentation use octal, decimal and hexadecimal in various places, and it can get confusing. I spent 15 minutes trying to get an example to work before realizing that the volume register for channel A was register 8 (decimal), not 10 as given in the example. The data value was in hexadecimal, so I assumed the register value was also (8 decimal = 8 hexadecimal = 10 octal). It wasn't! The register values in the ADS examples are in octal. They show the register values in decimal on their register map, while General Instrument's is in octal. This hodgepodge of number bases is confusing, so be careful.

### Last Things First

You now know enough about the Noisemaker to get it to make noise. But it is better to first discover how to get the Noisemaker to *stop* making noise. Listing 2 is a short program that I append to all of my Noisemaker programs; it produces silence.

Line 60010 sets the address of the board in the variable N. Variables N1, N2 and N3 are then set to the other I/O addresses used by the Noisemaker. Lines 60040 through 60060 make up a loop that zeroes out all of the registers on the Noisemaker board. Line 60050 actually performs the register access. The OUT N,I sets the pointer register of the first AY-3-8910 to the desired register I. The OUT N1,0 sets the register to zero. The remainder of the line zeroes out the same register in the other AY-3-8910. This procedure is performed for all 16 registers numbered 0 through 15 (decimal).

Now that you know how to shut the Noisemaker up, you can make it noisy. Listing 3 uses two simple alternating tones to make a siren. This program is the equivalent of the European siren example on page 10 of the ADS manual. Lines 1010 and 1020 set up the Noisemaker addresses as before. Tone generator A alone is used. Line 1040 sets the fine-tone period at 144. Line 1050 sets the coarse-tone period at zero. This results in a total tone period at 144 (0 × 256 + 144) for a frequency of approximately 868 Hz (125,000/144). Line 1060 enables the A tone generator with a 62, and line 1070 sets

```
1000 REM PROGRAM TO CALCULATE PROPER VALUES FOR TONE PERIOD REGISTERS
1010 REM  FOR THE NOISEMAKER BOARD, GIVEN THE SYSTEM CLOCK FREQUENCY.
1020 REM ********** ALL VALUES IN DECIMAL *************
1030 REM
1040 P=0\REM PRINTER SELECT CODE
1050 INPUT "ENTER THE SYSTEM BUS CLOCK FREQUENCY IN MHZ (i.e. 1,2 or 4) ",F
1060 F=F*1000000
1070 PRINT #P,"          FREQUENCY         PERIOD    COARSE   FINE"
1080 PRINT #P,"   DESIRED     ACTUAL       VALUE     VALUE    VALUE"
1090 PRINT #P
1100 REM CALCULATE NEAREST POSSIBLE FREQUENCY
1110 FOR I=1 TO 96
1120   READ T
1130   V=INT(F/(16*T))
1140   IF ABS(F/(16*(V-1))-T)<ABS(F/(16*V)-T) THEN V=V-1
1150   IF ABS(F/(16*(V+1))-T)<ABS(F/(16*V)-T) THEN V=V+1
1160  REM CALCULATE COARSE TUNE VALUE
1170   C=INT(V/256)
1180  REM CALCULATE FINE TUNE VALUE
1190   C1=V-(C*256)
1200  REM PRINT ALL INFORMATION
1210   PRINT #P,%12F3,T,F/(16*V),%8I,V,C,C1
1220  NEXT I
1230 END
1240 DATA 32.703,34.648,36.708,38.891
1250 DATA 41.203,43.654,46.249,48.999,51.913,55,58.270,61.735,65.406
1260 DATA 69.296,73.416,77.782,82.406,87.308,92.498,97.998,103.826
1270 DATA 110,116.540,123.47,130.812,138.592,146.832,155.564,164.812,174.616
1280 DATA 184.996,195.996,207.652,220,233.08,246.94,261.624,277.184,293.664
1290 DATA 311.128,329.624,349.232,369.992,391.992,415.304,440,466.16,493.88
1300 DATA 523.248,554.368,587.328,622.256,659.248,698.464,739.984,783.984
1310 DATA 830.608,880,932.32,987.76,1046.496,1108.736,1174.656,1244.512
1320 DATA 1318.496,1396.928,1479.968,1567.968,1661.216,1760,1864.640,1975.52
1330 DATA 2092.992,2217.472,2349.312,2489.024,2636.992,2793.856,2959.936
1340 DATA 3135.936,3322.432,3520,3729.28,3951.04,4185.984,4434.944,4698.624
1350 DATA 4978.048,5273.984,5587.712,5919.872,6271.872,6644.864,7040
1360 DATA 7458.56,7902.08
```

*Listing 1. Calculating register values in North Star BASIC for each note of the music scale.*

```
60000 REM RESET ALL ADS NOISEMAKER REGISTERS
60010 N=252\REM ADDRESS OF NOISEMAKER BOARD
60020 N1=N+1\N2=N+2\N3=N+3\REM REST OF NOISEMAKER ADDRESSES
60030 REM CLEAR ALL CHANNELS
60040 FOR I=0 TO 15
60050 OUT N,I\OUT N1,0\OUT N2,I\OUT N3,0
60060 NEXT I
60070 OUT N,0\REM RESET POINTER REGISTER
60080 END
```

*Listing 2. Silencing the Noisemaker.*

```
1000 REM EUROPEAN WARBLING SIREN EFFECT
1010 N=252\REM LOCATION OF NOISEMAKER BOARD
1020 N1=N+1\N2=N+2\N3=N+3\REM LOCATION OF THE REGISTERS
1030 FOR J=1 TO 10
1040 OUT N,0\OUT N1,144
1050 OUT N,1\OUT N1,0
1060 OUT N,7\OUT N1,62
1070 OUT N,8\OUT N1,15
1080 FOR I=1 TO 350\NEXT
1090 OUT N,0\OUT N1,85
1100 OUT N,1\OUT N1,1
1110 FOR I=1 TO 350\NEXT
1120 NEXT J
1130 OUT N,8\OUT N1,0
1140 END
```

*Listing 3. Siren program.*

```
1000 REM LASER SOUND EFFECT
1010 N=252\REM LOCATION OF NOISEMAKER BOARD
1020 N1=N+1\N2=N+2\N3=N+3\REM REST OF THE REGISTERS
1030 FOR I=0 TO 15
1040 OUT N,I\OUT N1,0
1050 NEXT I
1060 OUT N,7\OUT N1,62
1070 OUT N,8\OUT N1,15
1080 FOR I=27 TO 56
1090 OUT N,0\OUT N1,I
1100 FOR J=1 TO 5\NEXT J
1110 NEXT I
1120 OUT N,8\OUT N1,0
1130 END
```

*Listing 4. Laser sound effects program.*

```
1000 REM LASER SOUND EFFECT
1010 N=252\REM LOCATION OF NOISEMAKER BOARD
1020 N1=N+1\N2=N+2\N3=N+3\REM OTHER NOISEMAKER ADDRESSES
1030 FOR I=0 TO 15
1040  OUT N,I\OUT N1,0\OUT N2,I\OUT N3,0
1050 NEXT I
1060 OUT N,7\OUT N1,62\OUT N2,7\OUT N3,62
1070 OUT N,8\OUT N1,15\OUT N2,8\OUT N3,15
1080 OUT N,0\OUT N2,0
1090 FOR I=27 TO 109
1100  OUT N1,I\OUT N3,I
1110  FOR J=1 TO 35\NEXT J
1120 NEXT I
1130 OUT N,8\OUT N1,0\OUT N2,8\OUT N3,0
1140  REM EXPLOSION SOUND EFFECT
1150  OUT N,6\OUT N1,31\OUT N2,6\OUT N3,31
1160  OUT N,7\OUT N1,7\OUT N2,7\OUT N3,7
1170  OUT N,8\OUT N1,16\OUT N2,8\OUT N3,16
1180  OUT N,9\OUT N1,16\OUT N2,9\OUT N3,16
1190  OUT N,10\OUT N1,16\OUT N2,10\OUT N3,16
1200  OUT N,12\OUT N1,128\OUT N2,12\OUT N3,128
1210  OUT N,13\OUT N1,0\OUT N2,13\OUT N3,0
1220 END
```

*Listing 5. Whistling-bomb program.*

full volume (15).

A wait is performed for about 350 milliseconds on line 1080. There is no delay statement in North Star BASIC, so an empty FOR/NEXT loop makes do. The tone period is then changed by lines 1090 and 1100, setting the tone period to 341 ($1 \times 256 + 85$). This results in a frequency of 366 Hz. The outer FOR/NEXT loop on lines 1030 and 1120 repeats this process ten times, and then shuts off the volume on line 1130 by setting the A amplitude register to zero. You don't want to forget to shut off the sound.

Frequency sweeps are also possible. Listing 4 is the laser sound effect from the ADS manual, but written in BASIC. Lines 1010 and 1020 again set up the addresses, and lines 1030 through 1050 clear all registers to zero. Lines 1060 and 1070 set the Noisemaker to full volume and enable generator A alone. Lines 1080 through 1100 represent a loop that sweeps from a tone period of 27 to one of 56. The fine-tuning register is used, and the coarse tuning is left at zero. This sweep corresponds to a frequency sweep of from 4630 Hz to 2232 Hz. The sound is again cut off by zeroing the amplitude register on line 1120.

### Other Possibilities

This is a small part of what the programmable sound generator and the Noisemaker can do. There is also a white-noise generator on the chip that has a programmable noise frequency. When used in conjunction with the automatic sound envelope generator, you synthesize explosion sounds.

The envelope generator can be used to automatically vary the volume of the sound in set patterns. There is a shape control register (13) and a period control register pair (11 and 12). The envelope can be programmed to cycle continuously or only once.

Listing 5 produces a whistling-bomb effect. The laser effect of Listing 4 has been extended by including both chips and sweeping the tone period from 27 to 109. This whistle simulates the bomb-drop sound. The new portion of the program starts on line 1140. This is the explosion. Line 1150 sets the noise period to 31. This maximum period produces the lowest frequency noise.

Line 1160 sets register 7 to a 7. Since bits 1, 2 and 0 are high, the tone generators will be silent. Since bits 3, 4 and 5 are low, the noise will come through all three channels. Lines 1170 through 1190 set all amplitudes to automatic control by the envelope generator. Line 1200 sets the envelope period to 128, an intermediate value. Finally, line 1210 sets register 13 to zero, setting a decaying, one-cycle envelope and starting the explosion.

A truly infinite variety of sounds can be generated using the ADS Noisemaker. The stereo effects definitely make it worth the cost of buying two sound-generator chips. The range of sounds should be able to accommodate most any game imaginable, and the price for adding sound (after the initial purchase of the Noisemaker) can be only a few lines of BASIC. The ADS Noisemaker can provide many hours of interesting experimentation, if your coinhabitants can stand the noise. ■



Reader Service—see page 257

# No. 17

# Software with full support

## Purchasing our software is just the beginning. We then back it up with professional support:

■ Subscription to "LIFELINES" for automatic notifications of revisions! ■ Update service for software and documentation! ■ Telephone Hotline! ■ Overseas software export service!

**All Lifeboat programs require CP/M, unless otherwise stated.**

*Genuine CP/M for Apple II Available now!*

Software with Manual / Manual Alone

☐ **CP/M® FLOPPY DISK OPERATING SYSTEM**—Digital Research's operating system configured for many popular micro-computers and disk systems:

| System | Version | Price |
|---|---|---|
| *New* Apple II® SoftCard® with Z80 Microsoft BASIC version 5 with high resolution graphics | 2.x | 349/25 ◇ |
| North Star Single Density | 2.x | 170/25 |
| North Star Double/Quad | 2.x | 170/25 |
| Durango F-85 | 2.x | 170/25 |
| iCOM Micro-Disk 2411 | 1.4 | 145/25 |
| iCOM 3712 for MITS 88-2SIO Console | 1.4 | 170/25 * |
| iCOM 3712 for 3P+S/MITS SIO Rev non-zero console | 1.4 | 170/25 * |
| iCOM 3812 | 1.4 | 170/25 * |
| Mits 3202/Altair 8800 | 1.4 | 145/25 |
| Heath H8 + H17 | 1.4 | 145/25 Ⓜ |
| Heath H89 | 1.4 | 145/25 Ⓜ |
| Heath H89 by Magnolia | 2.x | 300/25 ◇ |
| Ohio Scientific C3 | 2.x | 200/25 |
| Onyx C8001 Standard | 2.x | 250/25 |
| Onyx C8001 Enhanced | 2.x | 330/25 |
| TRS-80 Model I | 1.4 | 145/25 Ⓜ |
| TRS-80 Model II | 2.x | 170/25 |
| TRS-80 Model II + Corvus | 2.x | 250/25 |
| Processor Technology Helios II | 1.4 | 145/25 |
| Intel MDS Single Density | 2.x | 170/25 |
| Intel MDS Double Density | 2.x | 170/25 |
| Micropolis Mod I | 2.x | 200/25 Ⓥ |
| Micropolis Mod II | 2.x | 200/25 Ⓥ |
| Mostek MDX STD Bus System | 2.x | 350/25 ** |

The following configurations are scheduled for release soon:

| System | Version | Price |
|---|---|---|
| North Star Double/Quad + Corvus | 2.x | 250/25 |
| Ohio Scientific C3-C | 2.x | 250/25 |
| iCOM 3812 | 2.x | 225/25 * |
| iCOM 4511/Pertec D3000 | 2.x | 375/25 * + |

*Software consists of the operating system, text editor, assembler, debugger and other utilities for file management and system maintenance. Complete set of Digital Research's documentation and additional implementation notes included. Systems marked * and ** include firmware on 2708 and 2716. Systems marked + include 5440 media charge. Systems marked Ⓜ require the special Ⓜ versions of software in this catalog. ◇ includes hardware addition to allow our standard versions of software to run under it.*

☐ **Z80 DEVELOPMENT PACKAGE**—Consists of: (1) disk file line editor, with global inter and intra-line facilities; (2) Z80 relocating assembler, Zilog/Mostek mnemonics, conditional assembly and cross reference table capabilities; (3) linking loader producing absolute Intel hex disk file .......... $95/$20

☐ **ZDT**—Z80 Monitor Debugger to break and examine registers with standard Zilog/Mostek mnemonic disassembly displays. $35 when ordered with Z80 Development Package .......... $50/$10

### AVOCET SYSTEMS

☐ **XASM-68**—Non-macro cross-assembler with nested conditionals and full range of pseudo operations. Assembles from standard Motorola MC6800 mnemonics to Intel hex .... $200/$25

☐ **XASM-65**—As XASM-68 for MOS Technology MCS-6500 series mnemonics .... $200/$25

☐ **XASM-48**—As XASM-68 for Intel MCS-48 and UPI-41 families .... $200/$25

☐ **XASM-18**—As XASM-68 for RCA 1802 .... $200/$25

☐ **DISTEL**—Disk based disassembler to Intel 8080 or TDL/Xitan Z80 source code, listing and cross reference files, Intel or TDL/Xitan pseudo ops optional. Runs on 8080 .... $65/$10

☐ **DISILOG**—As DISTEL to Zilog/Mostek mnemonic files .... $65/$10

☐ **SMAL/80** Structured Macro Assembler Language—Package of powerful general purpose text macro processor and SMAL structured language compiler. SMAL is an assembler language with IF-THEN-ELSE, LOOP-REPEAT-WHILE, DO-END, BEGIN-END constructs .... $75/$15

### PHOENIX SOFTWARE ASSOCIATES

☐ **PASM®**—Z80 macro assembler, Intel/TDL mnemonics. Generates Intel hex format or relocatable code in either TDL Object Module format or PSA Relocatable Binary Module format. Supports text insertion, conditional branching within macros, recursive macro calls and parameter passing .... $129/$25

☐ **EDIT**—Character oriented text file editor. Includes macro definition capabilities. Handles insertion, deletion, searching, block move, etc. for files of any length. Does not require a CRT .... $129/$25

*New* ☐ **PLINK®**—Two pass **disk-to-disk linkage editor/loader** which can produce re-entrant, ROMable code. Can link programs that are larger than available memory for execution targeted on another machine. Full library capabilities. Input can be PSA Relocatable Binary Module, TDL Object Module or **Microsoft REL files**. Output can be a COM file, Intel hex file, TDL Object Module or PSA Relocatable file .... $129/$25

*New* ☐ **BUG® and μBUG®**—Z80 interactive machine level debugging tools for program development. BUG has full symbolic trace and interactive assembly (mnemonics compatible with PASM). Dynamic breakpoints and conditional traps while tracing (even through ROM!). μBUG is a subset of BUG and is used in memory limited situations .... $129/$25

### DIGITAL RESEARCH

☐ **MP/M**—Installed for single density MDS-800. Multi-processing derivative of the CP/M operating system. Manual includes CP/M2 documentation .... $300/$50

☐ **MAC**—8080 Macro assembler. Full Intel macro definitions. Pseudo Ops include RPC, IRP, REPT, TITLE, PAGE, and MACLIB. Produces absolute hex output plus symbol table file for use by SID and ZSID (see below) .... $120/$15

☐ **SID**—8080 Symbolic debugger. Full trace, pass count and breakpoint program testing. Has backtrace and histogram utilities. When used with MAC, provides full symbolic display of memory labels and equated values .... $105/$15

☐ **ZSID**—Z80 Symbolic debugger with all features of SID .... $130/$15

☐ **TEX**—Text output formatter to create paginated, page-numbered and justified copy. Output can be directed to printer or disk .... $105/$15

☐ **DESPOOL**—Utility program to permit simultaneous printing from text files while executing other programs .... $80/$10

☐ **tiny C**—Interactive interpretive system for teaching structured programming techniques. Manual includes full source listings .... $105/$50

*New Version* ☐ **BDS C COMPILER**—Supports structures, unions, 2 dimensional arrays, pointers, recursion and overlays. Features optimized code generator, variable sized buffers for file I/O, and capability to produce ROMable code. Includes macro package to enable user to produce linkable modules with MAC (see under Digital Research). Floating point functions, full run-time package and machine code library sources provided. Linker, library manager and textbook included. Compiler lacks initializers, statics, floats and longs .... $145/$25

Software with Manual / Manual Alone

☐ **WHITESMITHS C COMPILER**—The ultimate in systems software tools. Produces faster code than a pseudo-code Pascal with more extensive facilities. Conforms to the full UNIX® Version 7 C language, described by Kernighan and Ritchie, and makes available over 75 functions for performing I/O, string manipulation and storage allocation. Linkable to Microsoft REL files. Requires 60K CP/M .... $630/$30

### MICROSOFT

☐ **BASIC-80**—Disk Extended BASIC, ANSI compatible with long variable names, WHILE/WEND, chaining, variable length file records. MBASIC version 4.51 also included on disk .... $325/$25

☐ **BASIC COMPILER**—Language compatible with BASIC-80 and 3-10 times faster execution. Produces standard Microsoft relocatable binary output. Includes MACRO-80. Also linkable to FORTRAN-80 or COBOL-80 code modules .... $350/$25

☐ **FORTRAN-80**—ANSI 66 (except for COMPLEX) plus many extensions. Includes relocatable object compiler, linking loader, library with manager. Also includes MACRO-80 (see below) .... $425/$25

*New* ☐ **COBOL-80**—Level 1 ANSI '74 standard plus most of Level 2. Full sequential, relative, and indexed file support with variable file names. Powerful interactive, formatted screen handling with ACCEPT and DISPLAY verbs. Program segmentation for execution of programs larger than memory and CHAIN command with parameter passing. Full support of CP/M version 2 files. Includes MACRO-80 (see above), linking loader, and relocatable library manager. Requires 48K CP/M .... $700/$25

☐ **MACRO-80**—8080/Z80 Macro Assembler. Intel and Zilog mnemonics supported. Relocatable linkable output. Loader, Library Manager and Cross Reference List utilities included .... $149/$15

☐ **XMACRO-86**—8086 cross assembler. All Macro and utility features of MACRO-80 package. Mnemonics slightly modified from Intel ASM86. Compatibility data sheet available .... $275/$25

☐ **EDIT-80**—Very fast random access text editor for text with or without line numbers. Global and intra-line commands supported. File compare utility included .... $89/$15

☐ **PASCAL/M®**—Compiles enhanced Standard Pascal to compressed efficient Pcode. Totally CP/M compatible. Random access files. Both 16 and 32-bit Integers. Runtime error recovery. Convenient STRINGs. OTHERWISE clause on CASE. Comprehensive manual (90 pp. indexed). SEGMENT provides overlay structure. INPORT, OUTPORT and untyped files for arbitrary I/O. Requires 56K CP/M. Specify 1) 8080 CP/M, 2) Z80 CP/M, or 3) Cromemco CDOS .... $175/$20

☐ **PASCAL/Z**—Z80 native code PASCAL compiler. Produces optimized, ROMable re-entrant code. All interfacing to CP/M is through the support library. The package includes compiler, relocating assembler and linker, and source for all library modules. Variant records, strings and direct I/O are supported. Requires 56K CP/M .... $395/$25

☐ **PASCAL/MT**—Subset of standard PASCAL. Generates ROMable 8080 machine code. Symbolic debugger included. Supports interrupt procedures, CP/M file I/O and assembly language interface. Real variables can be BCD, software floating point, or AMD 9511 hardware floating point. Includes strings enumerations and record data types. Manual explains BASIC-PASCAL conversion. Requires 32K .... $250/$30

☐ **APL/V80**—Concise and powerful language for application software development. Complex programming problems are reduced to simple expressions in APL. Features include up to 27K active workspace, shared variables, arrays of up to 8 dimensions, disk workspace and copy object library. The system also supports auxiliary processors for interfacing I/O ports. Requires 48K CP/M and serial APL printing terminal or CRT .... $500/$30

☐ **ALGOL-60**—Powerful block-structured language compiler featuring economical run-time dynamic allocation of memory. Very compact (24K total RAM) system implementing almost all Algol 60 report features plus many powerful extensions including string handling direct disk address I/O etc. .... $199/$20

☐ **CBASIC-2** Disk Extended BASIC—Non-interactive BASIC with pseudo-code compiler and run-time interpreter. Supports full file control, chaining, integer and extended precision variables, etc. Versions of CRUN for CP/M versions 1.4 and 2.x included on disk .... $120/$15

### MICRO FOCUS

☐ **STANDARD CIS COBOL**—ANSI '74 COBOL standard compiler fully validated by U.S. Navy tests to ANSI level 1. Supports many features to level 2 including dynamic loading of COBOL modules and a full ISAM file facility. Also, program segmentation, interactive debug and powerful interactive extensions to support protected and unprotected CRT screen formatting from COBOL programs used with any dumb terminal .... $850/$50

☐ **FORMS 2**—CRT screen editor. Output is COBOL data descriptions for copying into CIS COBOL programs. Automatically creates a query and update program of indexed files using CRT protected and unprotected screen formats. No programming experience needed. Output program directly compiled by STANDARD CIS COBOL .... $200/$20

Software with Manual / Manual Alone

*New* ☐ **NEVADA COBOL**—Subset of ANSI-74. Features fast compilation and execution with small object modules. Has extended arithmetic with 18 digit accuracy. Extended I/O includes random access files and sequential files of both fixed and variable length records, and interactive accept/display verbs. Good error messages and debugging facilities enhance program development. Requires a 32K CP/M system .... $149/$25

### EIDOS SYSTEMS

☐ **KBASIC**—Microsoft Disk Extended BASIC version 4.51 integrated with KISS Multi-Keyed Index Sequential and Direct Access file management as 9 additional BASIC commands. KISS included as relocatable modules linkable to FORTRAN-80, COBOL-80, and BASIC COMPILER. Specify CP/M version 1.4 or 2.x when ordering. Requires 48K CP/M $585/$45
To licensed users of Microsoft BASIC-80 (MBASIC) .... $435/$45

☐ **XYBASIC** Interactive Process Control BASIC—Full disk BASIC features plus unique commands to handle byte rotate and shift and to test and set bits. Available in several versions:

| | |
|---|---|
| Integer ROM squared | $350/$25 |
| Integer CP/M | $350/$25 |
| Extended ROM squared | $450/$25 |
| Extended CP/M | $450/$25 |
| Extended Disk CP/M | $550/$25 |
| Integer CP/M Run Time Compiler | $350/$25 |
| Extended CP/M Run Time Compiler | $450/$25 |

☐ **RECLAIM**—A utility to validate media under CP/M. Program tests a diskette or hard disk surface for errors, reserving the imperfections in invisible files, and permitting continued usage of the remainder. Essential for any hard disk. Requires CP/M version 2 .... $80/$5

☐ **BASIC UTILITY DISK**—Consists of: (1) CRUNCH-14—Compacting utility to reduce the size and increase the speed of programs in Microsoft BASIC 4.51, BASIC-80 and TRS-80 BASIC. (2) DPFUN—Double precision subroutines for computing nineteen transcendental functions including square root, natural log, log base 10, sine, arc sine, hyperbolic sine, hyperbolic arc sine, etc. Furnished in source on diskette and documentation .... $50/$35

☐ **STRING/80**—Character string handling plus routines for direct CP/M BDOS calls from FORTRAN and other compatible Microsoft languages. The utility library contains routines that enable programs to chain to a COM file, retrieve command line parameters and search file directories with full wild card facilities. Supplied as linkable modules in Microsoft format. $95/$20

☐ **STRING/80** source code available separately— .... *$295/NA*

☐ **THE STRING BIT**—FORTRAN character string handling. Routines to find, fill, pack, move, separate, concatenate and compare character strings. This package completely eliminates the problems associated with character string handling in FORTRAN. Supplied with source .... $65/$15

☐ **VSORT**—Versatile sort/merge system for fixed length records with fixed or variable length fields. VSORT can be used as a stand-alone package or loaded and called as a subroutine from CBASIC-2. When used as a subroutine, VSORT maximizes the use of buffer space by saving the TPA on disk and restoring it on completion of sorting. Records may be up to 255 bytes long with a maximum of 5 fields. Upper/lower case translation and numeric fields supported .... $175/$20

☐ **CPM/374X**—Has full range of functions to create or re-name an IBM 3741 volume, display directory information and edit the data set contents. Provides full file transfer facilities between 3741 volume data sets and CP/M files .... $195/$10

*Coming Soon*

**CPAids®**

☐ **MASTER TAX**—Professional tax preparation program. Prepares schedules A, B, C, D, E, F, G, R/RP, SE, TC, ES and forms 2106, 2119, 2210, 3468, 3903, 2441, 4625, 4726, 4797, 4972, 5695 and 6251. Printing can be on readily available, pre-printed continuous forms, on overlays, or on computer generated, IRS approved forms. Maintains client history files and is interactive with CPAids GENERAL LEDGER II (see below) .... $995/$30
Annual Update Fee .... $350

☐ **STANDARD TAX**—As above for schedules A, B, C, D, E, G, R/RP, SE, TC and forms 2106 and 2441. Also, does not maintain client history files .... $495/$30
Annual Update Fee .... $175

☐ **GENERAL LEDGER II**—Designed for CPA's. Stores complete 12 month detailed history of transactions. Generates financial statements, depreciation, loan amortizations, journals, trial balances, statements of changes in financial position, and compilation letters. Includes payroll system with automatic posting to general ledger. *Prints payroll register, W2's and payroll checks.* .... $450/$30



**Lifeboat Associates,** 1651 Third Avenue, N.Y., N.Y. 10028 **(212) 860-0300** Telex:220501

**Neu in der Schweiz Lifeboat Associates GmbH,** Aegeristr. 35, 6340 Baar **Telefon 042/31 2931**

T/MAKER—Powerful new tool for preparing management reports with tabular data. Makes financial modeling projects easy. Do you want a weekly profitability report? Set up the table and compute. Just change the sales figures for next week and compute. You have a new report! T/MAKER includes a full screen editor for setting up tables which pages left, right, up and down. Compute includes standard arithmetic, percents, exponents, common transcendental functions, averages, maxima, minima, projections, etc. Requires 48K CP/M, CBASIC-2, CRT Terminal with addressable cursor positioning ..... **$275/$25**

---

**BSTAM**—Utility to link one computer to another Ⓜ also equipped with BSTAM. Allows file transfers at full data speed (no conversion to hex), with CRC block control check for very reliable error detection and automatic retry. We use it! It's great! Full wildcard expansion to send *. COM, etc. 9600 baud with wire. 300 baud with phone connection. **Both** ends need one. Standard and Ⓜ versions can talk to one another. This software requires a knowledge of assembler language for installation. ..... **$150/$10**

**BSTMS**—Intelligent terminal program for Ⓜ CP/M systems. Permits communication between micros and mainframes. Sends character data files to remote computers under complete control. System can record character data sent from remote computer systems and data banks. Includes programs to EXPAND and COMPRESS binary files for transmission. This software requires a knowledge of assembler language for installation. ..... **$200/$25**

**WHATSIT?***—Interactive data-base system using associative tags to retrieve information by subject. Hashing and random access used for fast response. Requires CBASIC-2 **$175/$25**

**SELECTOR III-C2**—Data Base Processor to † create and maintain multi-key data bases. Ⓜ Prints formatted sorted reports with numerical summaries or mailing labels. Comes with sample applications, including Sales Activity, Inventory, Payables, Receivables, Check Register, and Client/Patient Appointments, etc. Requires CBASIC-2. Supplied in source ..... **$295/$20**

**GLECTOR**—General Ledger option to SELECTOR III-C2. Interactive system provides for customized COA. Unique chart of transaction types insure proper double entry bookkeeping. Generates balance sheets, P&L statements and journals. Two year record allows for statement of changes in financial position report. Supplied in source. Requires SELECTOR III-C2, CBASIC-2 and 56K system. ..... **$350/$25**

---

**DMA**

**CBS**—Configurable Business System is a † comprehensive set of programs for defining custom data files and application systems without using a programming language such as BASIC, FORTRAN, etc. Multiple key fields for each data file are supported. Set-up program customizes system to user's CRT and printer. Provides fast and easy interactive data entry and retrieval **with transaction processing**. Report generator program does complex calculations with stored and derived data, record selection with multiple criteria, and custom formats. Sample inventory and mailing list systems included. **No support language required** ..... **$395/$40**

---

**MICROPRO**

**SUPER-SORT I**—Sort, merge, extract utility as Ⓛ absolute executable program or linkable module in Microsoft format. Sorts fixed or variable records with data in binary, BCD, Packed Decimal, *EBCDIC, ASCII*, floating & fixed point, *exponential, field* justified, etc. Even variable number of fields per record! ..... **$225/$25**

**SUPER-SORT II**—Above available as abso-Ⓛ lute program only ..... **$175/$25**

**SUPER-SORT III**—As II without SELECT/Ⓛ EXCLUDE ..... **$125/$25**

**DATASTAR**—Professional forms control entry Ⓛ and display system for key-to-disk data capture. Menu driven with built-in learning aids. Input field verification by length, mask, attribute (i.e. upper case, lower case, numeric, auto-dup, etc.) Built-in arithmetic capabilities using keyed data, constant and derived values. Visual feedback for ease of forms design. Files compatible with CP/M-MP/M supported languages. Requires 32K CP/M ..... **$350/$35**

**WORD-STAR**—Menu driven visual word pro-Ⓛ cessing system for use with standard terminals. Text formatting performed on screen. Facilities for text paginate, page number, justify, center and underscore. User can print one document while simultaneously editing a second. Edit facilities include global search and replace, Read/Write to other text files, block move, etc. Requires CRT terminal with addressable cursor positioning ..... **$445/$40**

**WORD-STAR-MAIL-MERGE**—As above with Ⓛ option for production mailing of personalized documents with mail lists from DATASTAR or NAD ..... **$575/$40**

**WORD-MASTER** Text Editor—In one mode Ⓛ has superset of CP/M's ED commands including global searching and replacing, forwards and backwards in file in video mode, provides full screen editor for users with serial addressable-cursor terminal ..... **$145/$25**

New

**MAGIC WAND***—Word processing system with simple, easy to use full screen text editor and powerful print processor. Editor has all standard editing functions including text insert and delete, global search and replace, block move and library files for boiler plate text. Print processor formatting commands include automatic margins, pagination, headings & footings, centered and justified text. Also prints with true proportional spacing, merges with data files for automatic form letters, and performs run-time conditional testing for varied output. Requires 32K CP/M and CRT terminal with addressable cursor. ..... **$395/$40**

---

**TEXTWRITER III**—Text formatter to justify and Ⓜ paginate letters and other documents. Special features include insertion of text during execution from other disk files or console, permitting recipe documents to be created from linked fragments on other files. Has facilities for sorted index, table of contents and footnote insertions. Ideal for contracts, manuals, etc. Now compatible with Electric Pencil* and Word-Star prepared files ..... **$125/$20**

New

**DATEBOOK**—Program to manage time just like an office appointment book but using the speed and memory of a computer. Keeps track of three appointment schedules (three dental chairs, three attorneys, etc.) at once. Appointments consist of name, reason for the appointment, the date and time, and the length of the appointment. System can be quickly customized for the individual user. Many helpful features for making, changing, finding, and reporting appointments. Requires 48K CP/M and 180K bytes diskette storage. Not available for Apple CP/M. ..... **$295/$25**

---

New lower prices for application Software

**PEACHTREE SOFTWARE***

General accounting software for small busi-Ⓛ nesses. Each product can be used alone or with † automatic posting to the general ledger. Supplied in source for Microsoft BASIC 4.51.

| | |
|---|---|
| GENERAL LEDGER | $530/$40 |
| ACCOUNTS PAYABLE | $530/$40 |
| ACCOUNTS RECEIVABLE | $530/$40 |
| PAYROLL | $530/$40 |
| INVENTORY | $660/$40 |

Other application products supplied in source Ⓛ for Microsoft BASIC 4.51.

| | |
|---|---|
| † MAILING ADDRESS | $530/$40 |
| PROPERTY MANAGEMENT | $925/$40 |

**GRAHAM-DORIAN SOFTWARE SYSTEMS**

Comprehensive accounting software written in Ⓛ CBASIC-2 and supplied in source code. Each Ⓜ software package can be used as a stand-† alone system or integrated with the General Ledger for automatic posting to ledger accounts. Requires CBASIC-2.

| | |
|---|---|
| GENERAL LEDGER | $805/$40 |
| ACCOUNTS PAYABLE | $805/$40 |
| ACCOUNTS RECEIVABLE | $805/$40 |
| INVENTORY SYSTEM | $555/$40 |
| JOB COSTING | $805/$40 |
| APARTMENT MANAGEMENT | $805/$40 |
| CASH REGISTER | $805/$40 |

**POSTMASTER**—A comprehensive package Ⓜ for mail list maintenance that is completely menu driven. Features include keyed record extraction and label production. A form letter program is included which provides neat letters on single sheet or continuous forms. Includes NAD file translator. Requires CBASIC-2. ..... **$150/$20**

**STRUCTURED SYSTEMS GROUP**

Complete interactive accounting software for † business. Each product can be used standalone or with automatic posting to the general ledger. Each product is thoroughly tested and very well documented. Each product requires CBASIC-2.

| | |
|---|---|
| GENERAL LEDGER | $820/$40 |
| ACCOUNTS RECEIVABLE | $820/$40 |
| ACCOUNTS PAYABLE | $820/$40 |
| PAYROLL | $820/$40 |
| INVENTORY CONTROL | $820/$40 |

**LIFELINES**

**NEWSLETTER FROM LIFEBOAT**

LIFELINES is the first step in software support for the serious microcomputer user. Each issue reports new revisions together with information on the purpose for each such release, be it for correction of 'bugs' or the addition of features and facilities.

**Feature Articles ! New Software ! Product Comparisons ! Info on CP/M Users Group !**

**SUBSCRIPTION INFORMATION:**

$18 for twelve issues: U.S., Canada, and Mexico.

$40 for twelve issues: all other countries.

$2.50 for each back issue: U.S., Canada, and Mexico.

$3.60 for each back issue: all other countries. Send Check to LIFELINES, 1651 Third Avenue, New York, N.Y. 10028 or use your VISA or MASTERCARD—call (212) 722-1700

**ANALYST**—Customized data entry and report-† ing system. User specifies up to 75 data items per record. Interactive data entry, retrieval, and update facility makes information management easy. Sophisticated report generator provides customized reports using selected records with multiple level breakpoints for summarization. Requires a disk sort utility such as QSORT, SUPER-SORT or VSORT and CBASIC-2 ..... **$250/$15**

**LETTERIGHT**—Program to create, edit and type letters or other documents. Has facilities to enter, display, delete and move text, with good video screen presentation. Designed to integrate with NAD for form letter mailings. Requires CBASIC-2 ..... **$200/$25**

**NAD** Name and Address selection system—Interactive mail list creation and maintenance program with output as full reports with reference data or restricted information for mail labels. Transfer system for extraction and transfer of selected records to create new files. Requires CBASIC-2 ..... **$100/$20**

**QSORT**—Fast sort/merge program for files with fixed record length, variable field length information. Up to five ascending or descending keys. Full back-up of input files created ..... **$100/$20**

**CONDIMENTS**

**HEAD CLEANING DISKETTE**—Cleans the drive Read/Write head in 30 seconds. Diskette absorbs loose oxide particles, fingerprints, and other foreign particles that might hinder the performance of the drive head. Lasts at least 3 months with daily use. Specify 5" or 8".
Single sided ..... **$20 each/$55 for 3**
Double sided ..... **$25 each/$65 for 3**

**DC 300 Data Cartridges** Specify 450'XL or 300' certified. Pack of 5. ..... **$100**

**FLIPPY DISK KIT**—Template and instructions to modify single sided 5¼" diskettes for use of second side in single sided drives ..... **$12.50**

**FLOPPY SAVER**—Protection for center holes for 5" and 8" floppy disks. Only 1 needed per diskette. Kit contains centering post, pressure tool and tough 7 mil mylar reinforcing rings for 25 diskettes.

| | |
|---|---|
| 5", Kit | $14.95 |
| 5", Rings only | $7.95 |
| 8", Kit | $16.95 |
| 8", Rings only | $8.95 |

**PASCAL USER MANUAL AND REPORT**—By Jensen and Wirth. The standard textbook on the language. Recommended for use by Pascal/Z, Pascal/M and Pascal/MT users **$12**

**THE C PROGRAMMING LANGUAGE**—By Kernighan and Ritchie. The standard textbook on the language. Recommended for use by BDS C, tiny C, and Whitesmiths C users ..... **$12**

**STRUCTURED MICROPROCESSOR PROGRAMMING**—By the authors of SMAL/80. Covers structured programming, the 8080/8085 instruction set and the SMAL/80 language ..... **$20**

**ACCOUNTS PAYABLE & ACCOUNTS RECEIVABLE—CBASIC**—By Osborne/McGraw-Hill ..... **$20**

**GENERAL LEDGER—CBASIC**—By Osborne/McGraw-Hill ..... **$20**

**PAYROLL WITH COST ACCOUNTING—*CBASIC***—*by Osborne/McGraw-Hill* ..... **$20**

**Hearty Appetite.**

*CP/M and MP/M are trademarks of Digital Research.
Z80 is a trademark of Zilog, Inc.
UNIX is a trademark of Bell Laboratories.
WHATSIT? is a trademark of Computer Headware.
Electric Pencil is a trademark of Michael Shrayer Software.
TRS-80 is a trademark of Tandy Corp.
Pascal/M is a trademark of Sorcim.
SoftCard is a trademark of Microsoft.
Apple is a trademark of Apple Computer.
PASM, PLINK, BUG and $\mu$BUG are trademarks of Phoenix Software Associates Ltd.
CPAids is a trademark of Computer Tax Service, Inc.
MAGIC WAND is a trademark of Small Business Application, Inc.
Peachtree Software is a trademark of Retail Sciences, Inc.

†Recommended system configuration consists of 48K CP/M, 2 full size disk drives, 24 x 80 CRT and 132 column printer.

Ⓜ Modified version available for use with CP/M as implemented on Heath and TRS-80 Model I computers.

Ⓛ User license agreement for this product must be signed and returned to Lifeboat Associates before shipment may be made.

Ⓘ This product Includes/eXcludes the language Ⓧ manual recommended in Condiments.

Ⓢ Serial number of CP/M system must be supplied with orders.

Ⓩ Requires Z80 CPU.

# Ordering Information

**MEDIA FORMAT ORDERING CODES**
**When ordering, please specify format code.**

**LIFEBOAT ASSOCIATES MEDIA FORMATS LIST.** Diskette, cartridge disk and cartridge tape format codes to be specified when ordering software for listed computer or disk systems. All software products have specific requirements in terms of hardware or software support, such as MPU type, memory size, support operating system or language.

| Computer system | Format Code |
|---|---|
| Altair 8800 Disk | See MITS 3200 |
| Altos | A1* |
| Apple · SoftCard 13 Sector | RG |
| Apple + SoftCard 16 Sector | RR |
| AVL Eagle | RB |
| BASF System 7100 | RD |
| Blackhawk Single Density | Q3 |
| Blackhawk Micropolis Mod II | Q2 |
| CDS Versatile 3B | Q1 |
| CDS Versatile 4 | Q2 |
| COMPAL-80 | Q2 |
| Cromemco System 3 | A1* |
| Cromemco Z2D | R6 |
| CSSN BACKUP (tape) | T1 # |
| Delta | A1* |
| Digi-Log Microterm II | RD |
| Digital Microsystems | A1* |
| Discus | See Morrow Discus |
| Durango F-85 | RL |
| Dynabyte DB8/2 | R1 |
| Dynabyte DB8/4 | A1* |
| Exidy Sorcerer · Lifeboat CP/M | Q2 |
| Exidy Sorcerer + Exidy CP/M | Q4 |
| Heath H8 + H17/H27 | P4 |
| Heath H89 + Lifeboat CP/M | P4 |
| Heath H89 · Magnolia CP/M | P7 |
| Helios II | See Processor Technology |
| Horizon | See North Star |
| iCOM 2411 Micro Floppy | R3 |
| iCOM 3712 | A1 |
| iCOM 3812 | A1* |

| Computer system | Format Code |
|---|---|
| iCOM 4511 5440 Cartridge CP/M 1 4 | D1 # |
| iCOM 4511 5440 Cartridge CP/M 2 2 | D2 # |
| IMS 5000 | RA |
| IMS 8000 | A1* |
| IMSAI VDP-40 | R4** |
| IMSAI VDP-42 | R4** |
| IMSAI VDP-44 | R5** |
| IMSAI VDP-80 | A1** |
| Intecolor | See ISC Intecolor |
| Intel MDS Single Density | A2 |
| Intel MDS Double Density | A5 |
| Intertec SuperBrain DOS 0.1 | R7 |
| Intertec SuperBrain DOS 0.5-2 X | RJ |
| Intertec SuperBrain DOS 3 X | RK |
| ISC Intecolor 8063/8360/8963 | A1 |
| Kontron PSI-80 | RF |
| Meca 5¼ | P6 |
| Micromation (Except TRS-80 below) | A1* |
| Micropolis Mod I | Q1 |
| Micropolis Mod II | Q2 |
| MITS 3200/3202 | B1 |
| Morrow Discus | A1* |
| Mostek | A1 |
| MSD 5¼ | RC |
| North Star Single Density | P1 |
| North Star Double/Quad | P2 |
| Nylac Single Density | Q3 |
| Nylac Micropolis Mod. II | Q2 |
| Ohio Scientific C3 | A3 |
| Onyx C8001 | T2 # |
| Pertec PCC 2000 | A1* |
| Processor Technology Helios II | B2 |
| Quay 500 | RO |
| Quay 520 | RP |
| RAIR Single Density | R9 |

| Computer system | Format Code |
|---|---|
| RAIR Double Density | RE |
| Research Machines 8" | A1 |
| Research Machines 5¼" | RH |
| REX | Q3 |
| Sanco 7000 5¼ | RQ |
| SD Systems 8" | A1* |
| SD Systems 5¼ | R3 |
| Sorcerer | See Exidy Sorcerer |
| Spacebyte | A1 |
| SuperBrain | See Intertec |
| Tarbell | A1* |
| TEI 5¼ | R3 |
| TEI 8" | A1* |
| Thinkertoys | See Morrow Discus |
| TRS-80 Model I 5¼" | R2 |
| TRS-80 Model I + FEC Freedom | RN |
| TRS-80 Model I + Micromation | A4* |
| TRS-80 Model I + Omikron 5¼" | RM |
| TRS-80 Model I · Omikron 8" | A1 |
| TRS-80 Model I + Shuffleboard 8" | A1 |
| TRS-80 Model II | A1* |
| VDP-40/42/44/80 | See IMSAI |
| Vector Graphic | Q2 |
| Vector MZ | Q2 |
| Versatile | *See CDS Versatile* |
| Vista V80 5¼ Single Density | P5 |
| Vista V200 5¼ Double Density | P6 |
| Zenith Z89 + Lifeboat CP/M | P4 |
| Zenith Z89 · Magnolia CP/M | P7 |

Prices reflect distribution on 8" single density diskettes. If a format is requested which requires additional diskettes, a surcharge of $8. per additional diskette will be added.

Prices F.O.B. New York. Shipping, handling and C.O.D. charges extra.

Manual cost applicable against price of subsequent software purchase.

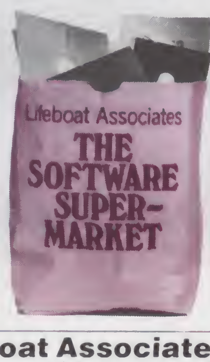
The sale of each proprietary software package conveys a license for use on one system only.

* Single-Side Single-Density disks are supplied for use with Double-Density and Double-Side 8" soft sector format systems

** IMSAI formats are single density with directory offset of zero

\# A media surcharge of $25 for orders on tape formats T1 and T2 and of $100 for orders on disk formats D1 and D2 will be added.

The list of available formats is subject to change without notice. In case of uncertainty, call to confirm the format code for any particular equipment.





**Lifeboat Associates**
1651 Third Avenue, N.Y., N.Y. 10028
**(212) 860-0300**

# Super Sound with Your Superboard II

*This simple and inexpensive modification unlocks Superboard's silent secrets.*

*D. Kupke*
*8 Lomond Drive*
*Toronto, Ontario*
*M8X 2W3*

OSI Superboard manuals hint at a lot of hidden features but fail to reveal how to implement them. Through research and discussions with other Superboard owners, I uncovered one of these features: *sound*.

All you need are resistors, diodes, one capacitor and a tape recorder. If you own a tape recorder, the rest of the hardware amounts to less than a dollar, and the software is exercise for your fingers.

### Hardware

Sheet 13 of OSI's circuit diagrams refers to sound and joysticks. The drawings are correct, but omit the values for resistors R67 to R71. The little diode-resistor network is a simple four-bit (R2 to R5) D/A converter routed to pins 11 and 12 of J4; the connector is on the left-hand side of the board. R67 is just a pull-up resistor. R68 and R71 form the ladder; each resistor is twice the value of the preceding one (see Fig. 1).

Good soldering practice should produce clean joints without runover onto adjacent foil patterns (see Photo 1).

You are now ready to attach the speaker to pins 11 and 12 of J4, the connector on the left side of the board, and here are a few suggestions.

The output from this little D/A converter is low, and a two-inch speaker (8 ohms) produces a feeble sound. You can build a small amplifier using an LM380N as suggested by Rod Hallen in "Audio for Your Microcomputer" (*Microcomputing*, February 1980, p. 32). (I used my tape recorder as an amplifier.)

Connect an audio cable to pins 11 and 12 with a phone plug on the other end and plug it into the auxiliary input of your tape recorder. Now you can plug a large extension speaker into the tape recorder and get volume to spare. The trick is to put the recorder in the record mode. You don't even need to put a cassette into your tape recorder. Just push the little tap, which is normally moved by the cassette, with your finger to engage the record button.

I routed all connections from J4 to the back of my home-built case for the Superboard. Pins 11 and 12 terminate in a phone jack; the remaining pins, 1–10, terminate in an RS-232 connector (see Photo 2).

When you turn on the system and the tape recorder, you will hear a high-pitched sound interrupted by a low-pitched sound every time you touch the keyboard. This indicates that everything is working as intended. What remains is to develop some software to produce the desired sounds. You can't turn the sound off before you run programs, so plug the speaker in just before entering RUN.

```
10  REM TEST PROGRAM FOR D/A CONVERTER
20  POKE 57088,0          turn speaker on
30  GOSUB 100             time delay
40  POKE 57088,1          turn speaker off
50  GOSUB 100             time delay
60  GOTO 20               repeat
100 FOR I = 0 TO 50
110 NEXT I
120 RETURN
```

*Listing 1a. Simple program to exercise your new D/A converter. A low-frequency sound is emitted.*

```
5   A = 57088
20  POKE A,0:GOSUB 100:POKE A,1:GOSUB 100:GOTO 20
100 RETURN
```

*Listing 1b. This program produces a higher frequency and could be used to simulate a small aircraft or tank.*

```
0300  8D 00 DF         STA  $DF00   turn speaker on
0303  20 20 03         JSR  $0320   go to delay
0306  EE 00 DF         INC  $DF00   turn speaker off
0309  20 20 03         JSR  $0320   go to delay
030C  4C 00 03         JMP  $0300   repeat

0320  A6 28     delay  LDX  $28     get frequency value
0322  E8        loop   INX          increase it by 1
0323  E0 00            CPX  $#00    compare with zero
0325  30 FB            BMI          branch to loop
0327  60               RTS          return
```

*Listing 2. Machine-code program similar to Listing 1.*

```
0300 8D 00 DF      STA $DF00 turn speaker on
0303 EE 00 DF      INX $DF00 turn speaker off
0306 A6 28         LDX $28   load maximum frequency
0308 CA       loop DEX
0309 D0 FD         BNE
030B C6 28         DEC $28
030D 4C 00 03      JMP $0300 repeat
```

*Listing 3. Program that generates a siren sound.*

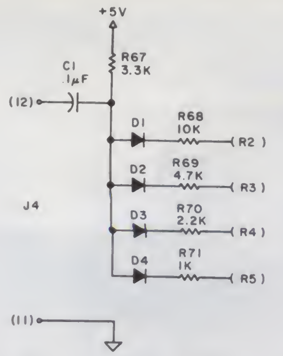



*Fig. 1. Resistor values omitted in OSI's circuit diagrams.*

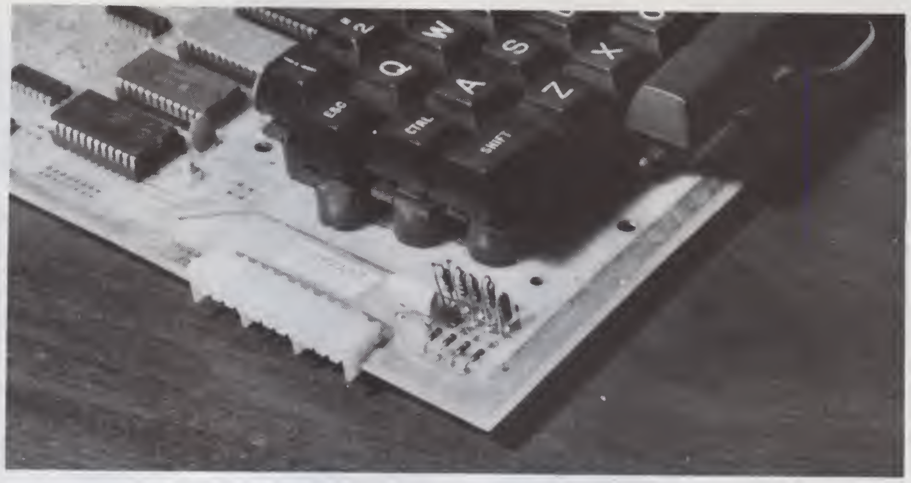


*Photo 1. D/A converter modification.*

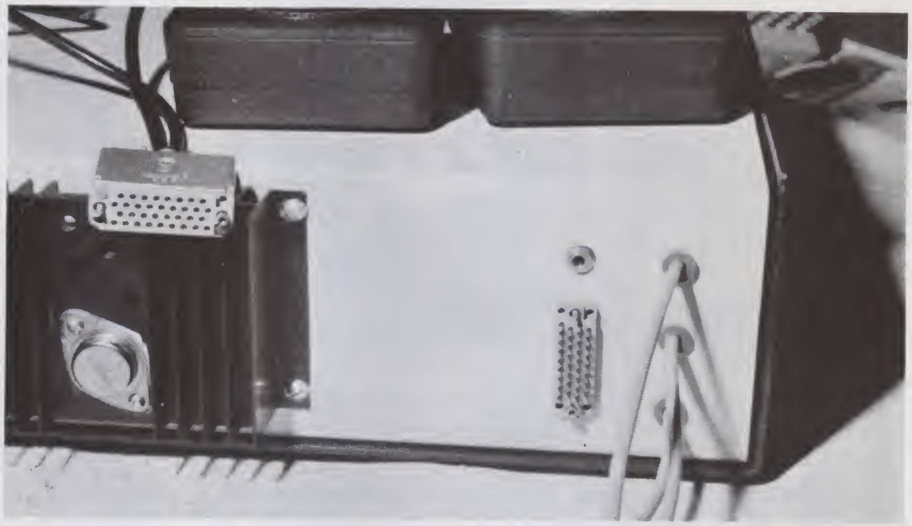


*Photo 2. Connections were rerouted to the back of my home-built case for the Superboard.*

**Software**

Even though OSI's Microsoft BASIC is fast, it limits the sound spectrum.

From the memory map in the user manual you get the location of the keyboard port (DF00,57088), so you can use Listing 1a to activate the speaker. This produces a simple, low-frequency square wave. Modifying the program (Listing 1b) only increases the frequency by a small amount, and the sound approximates that of a small airplane.

This small change in BASIC shows audibly that the frequency is related to the efficiency of your programming. Although you can experiment with this BASIC program and use it for sound effects, machine language is the solution.

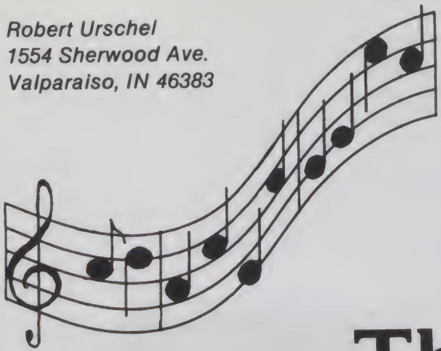
If you have the extended monitor, so much the better, but the standard monitor by OSI is adequate. Listing 2 shows a short machine-code program that follows the lines of Listing 1a. The value for the delay loop is stored at location 0028H. A good value to start with is 80H. Load this register with hex values 80 to C4, and you'll get all the tones of one octave. Listing 3 contains a machine-code program that simulates the sound of a siren. Again, the value of the maximum frequency must be loaded somewhere on page zero.

**Conclusion**

In my application for a simple way to get sound from your Superboard, you use only the middle four bits, because the board is prepared for this arrangement. It's easy to convert the whole eight-bit word. The incentive for this improvement is that different four-bit words produce different sounds, but also different levels of volume. A little program I wrote to produce a whole octave in response to keyboard entries 0–7 works fine but suffers from the above-mentioned volume problem. Rodnay Zaks' 6502 applications book shows a similar program, but it needs some modifications to suit the OSI Superboard. ■

✓ Reader Service—see page 257

Robert Urschel
1554 Sherwood Ave.
Valparaiso, IN 46383



# The GI Programmable Sound Generator

*This music/sound effects chip has a wide enough range of noise to suit any musician/computerist.*

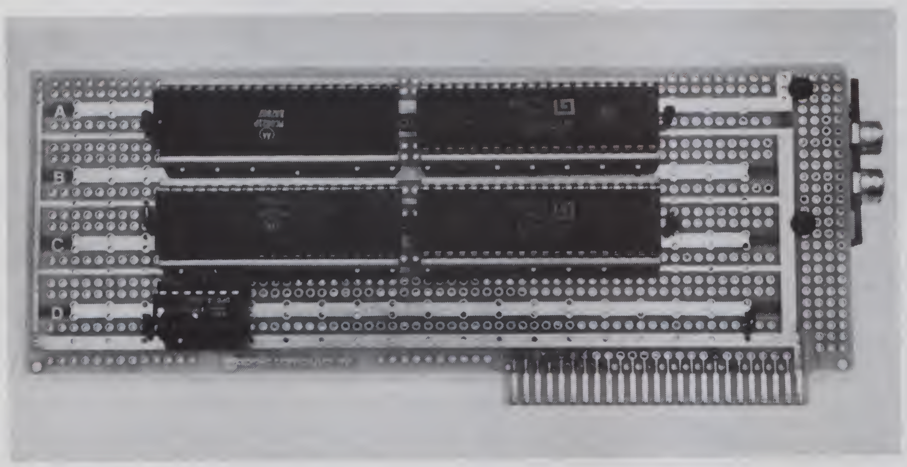


Photo 1. Component side of circuit board. (Photos by Joe Urschel)

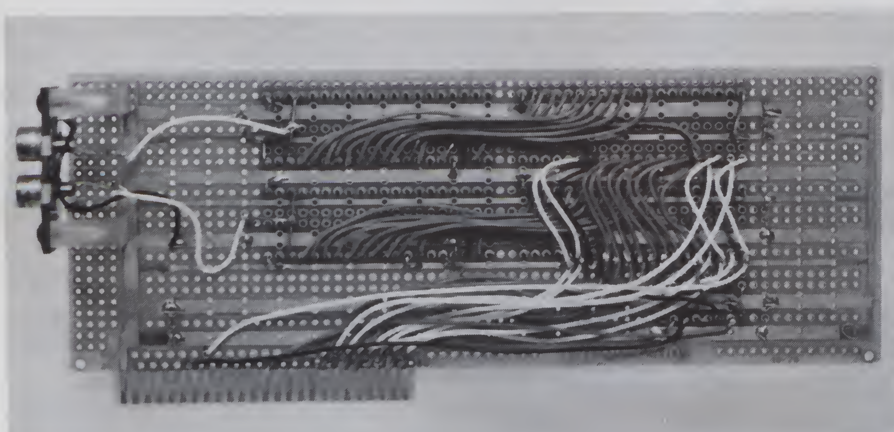


Photo 2. Wired side of circuit board.

The Apple II computer has its own internal speaker capable of producing music one note at a time. But if you want to use your computer for serious music, a better method is available—the AY-3-8910 Programmable Sound Generator (PSG) from General Instrument Corp.

The PSG can play three notes simultaneously. It can also make many types of sound effects, such as explosions, gunshots and whistling bombs.

A noise generator produces a wide range of pseudorandom frequencies. Thus, once the PSG is addressed to make a sound effect or note, the computer is free to perform other tasks.

The PSG contains 16 eight-bit registers, which control all functions. Some of the registers do not use all eight bits. The first six control the frequencies of tone channels A, B and C (see Fig. 1). To produce a simple tone on channel A, for example, registers 0 and 1 are loaded with a value proportional to the desired frequency; i.e., the lower the value in the register, the higher the frequency produced.

The value in the register is counted down to zero at a rate controlled by a master clock frequency. When the value of the register reaches zero, the output for channel A is toggled. The register is again counted down and the output is again toggled. This produces a 50 percent duty cycle squarewave output. I used the 1 MHz clock frequency available on the Apple bus as the master clock frequency.

With a hexadecimal value of $8E loaded

into register 0 and with register 1 set to 0, the PSG will produce a frequency of 440 Hz, or A above middle C. Refer to Table 1 for register values for notes. (Any value preceded by a dollar sign indicates a hexadecimal value.)

The amplitude, or volume, of each channel can be controlled via registers 8, 9 and A. With bit B4 set to 0, the amplitude of the tone has 16 different levels as set by bits B0 through B3. For example, loading register 8 with a value of $01 will produce the softest volume for channel A, while loading the register with a value of $0F will produce the loudest volume.

With bit B4 set to 1, the amplitude is controlled by the Envelope Period register (registers B and C) and by the Envelope Shape/Cycle register (register D). If bit B4 is set, then bits B0 through B3 have no effect.

The envelope period, registers B and C, is also a function of the master clock frequency. The higher the value in this register, the longer the note will take to decay (or attack again, depending on the setting of register D).

There are many other possibilities using register D; these are explained in the PSG data manual.

### The 6821 Peripheral Interface Adapter

Data and addresses are sent from the Apple II bus to the PSG via a 6821 peripheral interface adapter (PIA). The PIA is a general input/output chip, and is a natural choice for interfacing the PSG to the Apple II. Although the PIA is very complex, I will try to simplify the method used to interface the PIA to the PSG music chip.

The PIA contains six eight-bit registers, three for each set of I/O lines. These are a data direction register (DDR), a control register and an eight-bit parallel I/O register.

Two sets of eight parallel I/O lines (16 lines total) can be set up as inputs or outputs. Only ten of these lines are needed—eight for the address/data lines on the PSG and two for the control lines on the PSG.

The first function of the controlling program is to set the I/O lines on the PIA to all outputs (see Program Listing). This is done in lines 1250 through 1290 by writing all 1's to the DDR. Lines 1300 through 1340 instruct the PIA to load data into the I/O registers instead of the DDR. This is done by setting bit 2 of the control register. This is the only time that the program is directly concerned with the PIA.

### Interfacing to the Apple II

On the inside of the Apple II computer towards the back are eight peripheral I/O connectors. Writing to certain addresses in the Apple memory will cause a control line

| REGISTER | | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
|---|---|---|---|---|---|---|---|---|---|
| 0 | CHANNEL A | 8 BIT FINE TUNE A | | | | | | | |
| 1 | TONE PERIOD | | | | | COARSE TUNE A | | | |
| 2 | CHANNEL B | 8 BIT FINE TUNE B | | | | | | | |
| 3 | TONE PERIOD | | | | | COARSE TUNE B | | | |
| 4 | CHANNEL C | 8 BIT FINE TUNE C | | | | | | | |
| 5 | TONE PERIOD | | | | | COARSE TUNE C | | | |
| 6 | NOISE PERIOD | | | | 5 BIT PERIOD CONTROL | | | | |
| 7 | $\overline{\text{ENABLE}}$ | $\overline{\text{IN}}$/OUT | | $\overline{\text{NOISE}}$ | | | $\overline{\text{TONE}}$ | | |
| | | IOB | IOA | C | B | A | C | B | A |
| 8 | CHANNEL A AMPLITUDE | | | | M | L3 | L2 | L1 | L0 |
| 9 | CHANNEL B AMPLITUDE | | | | M | L3 | L2 | L1 | L0 |
| A | CHANNEL C AMPLITUDE | | | | M | L3 | L2 | L1 | L0 |
| B | ENVELOPE | 8 BIT FINE TUNE E | | | | | | | |
| C | PERIOD | 8 BIT COARSE TUNE E | | | | | | | |
| D | ENVELOPE SHAPE/CYCLE | | | | | CONT | ATT | ALT | HOLD |
| E | I/O PORT A | 8 BIT PARALLEL PORT A | | | | | | | |
| F | I/O PORT B | 8 BIT PARALLEL PORT B | | | | | | | |

*Fig. 1. Registers and their associated function. Register numbers are in hexadecimal. Note that some registers do not use all eight bits.*

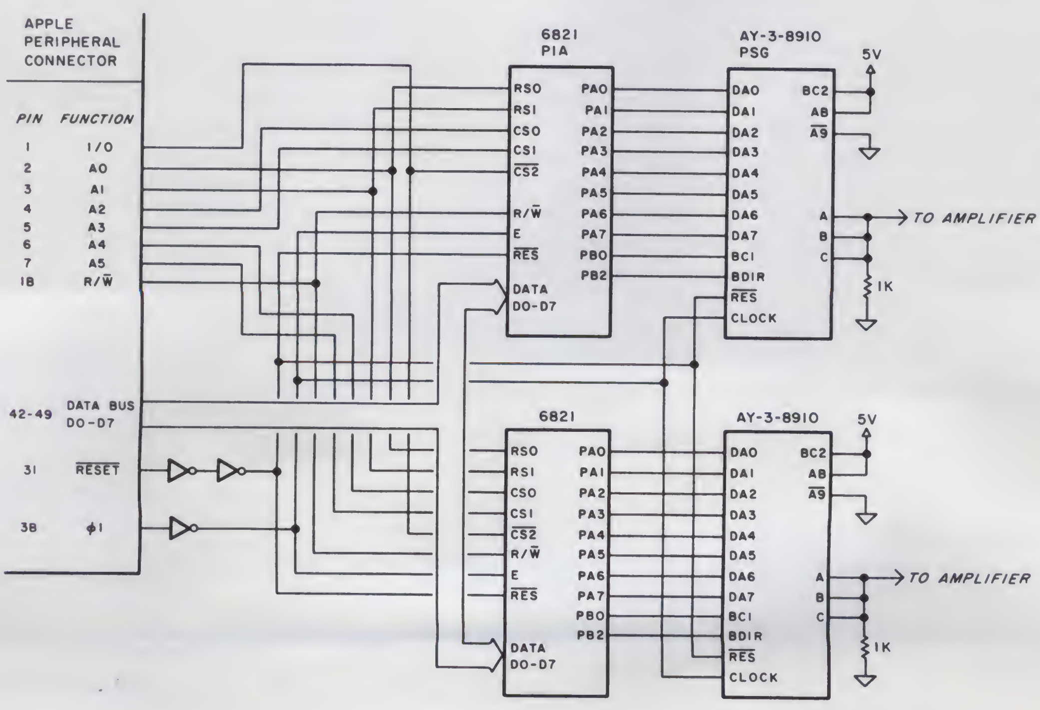



*Fig. 2. Schematic drawing of Apple prototyping board.*

| DESIRED FREQUENCY | ACTUAL FREQUENCY | NOTE | REGISTER VALUE IN HEX COARSE/FINE |
|---|---|---|---|
| 27.5 | 27.4967004 | A | 08 E1 |
| 29.1352351 | 29.1375291 | A# | 08 61 |
| 30.8677063 | 30.8641975 | B | 07 E9 |
| 32.7031957 | 32.7053898 | C | 07 77 |
| 34.6478289 | 34.6452328 | C# | 07 0C |
| 36.708096 | 36.6999413 | D | 06 A7 |
| 38.890873 | 38.892346 | D# | 06 47 |
| 41.2034447 | 41.1997363 | E | 05 ED |
| 43.653529 | 43.6452514 | F | 05 98 |
| 46.2493029 | 46.2620281 | F# | 05 47 |
| 48.9994296 | 48.9811912 | G | 04 FC |
| 51.9130873 | 51.910299 | G# | 04 B4 |
| 55 | 55.0176057 | A | 04 70 |
| 58.2704702 | 58.2479031 | A# | 04 31 |
| 61.7354127 | 61.7588933 | B | 03 F4 |
| 65.4063914 | 65.376569 | C | 03 BC |
| 69.2956578 | 69.2904657 | C# | 03 86 |
| 73.4161921 | 73.4430082 | D | 03 53 |
| 77.781746 | 77.7363184 | D# | 03 24 |
| 82.4068893 | 82.4538259 | E | 02 F6 |
| 87.307058 | 87.2905028 | F | 02 CC |
| 92.4986058 | 92.4556213 | F# | 02 A4 |
| 97.9988592 | 97.9623825 | G | 02 7E |
| 103.826175 | 103.820598 | G# | 02 5A |
| 110 | 110.035211 | A | 02 38 |
| 116.54094 | 116.604478 | A# | 02 18 |
| 123.470825 | 123.517787 | B | 01 FA |
| 130.812783 | 130.753138 | C | 01 DE |
| 138.591316 | 138.580931 | C# | 01 C3 |
| 146.832384 | 146.713615 | D | 01 AA |
| 155.563492 | 155.472637 | D# | 01 92 |
| 164.813779 | 164.907652 | E | 01 7B |
| 174.614116 | 174.581006 | F | 01 66 |
| 184.997212 | 184.911243 | F# | 01 52 |
| 195.997718 | 195.924765 | G | 01 3F |
| 207.652349 | 207.641196 | G# | 01 2D |
| 220 | 220.070423 | A | 01 1C |
| 233.081881 | 233.208955 | A# | 01 0C |
| 246.941651 | 247.035573 | B | 00 FD |
| 261.625565 | 261.506276 | C | 00 EF |
| 277.182631 | 277.777778 | C# | 00 E1 |
| 293.664768 | 293.42723 | D | 00 D5 |
| 311.126984 | 310.945274 | D# | 00 C9 |
| 329.627557 | 328.947369 | E | 00 BE |
| 349.228232 | 349.162011 | F | 00 B3 |
| 369.994423 | 369.822485 | F# | 00 A9 |
| 391.995437 | 393.081761 | G | 00 9F |
| 415.304698 | 416.666667 | G# | 00 96 |
| 440 | 440.140845 | A | 00 8E |
| 466.163762 | 466.417911 | A# | 00 86 |
| 493.883301 | 492.125984 | B | 00 7F |
| 523.251131 | 525.210084 | C | 00 77 |
| 554.365262 | 553.097345 | C# | 00 71 |
| 587.329536 | 589.622642 | D | 00 6A |
| 622.253968 | 625 | D# | 00 64 |
| 659.255115 | 657.894737 | E | 00 5F |
| 698.456464 | 702.247191 | F | 00 59 |
| 739.988847 | 744.047619 | F# | 00 54 |
| 783.990873 | 781.25 | G | 00 50 |
| 830.609397 | 833.333333 | G# | 00 4B |
| 880 | 880.281691 | A | 00 47 |
| 932.327523 | 932.835821 | A# | 00 43 |
| 987.766603 | 992.063492 | B | 00 3F |
| 1046.50226 | 1041.66667 | C | 00 3C |
| 1108.73052 | 1116.07143 | C# | 00 38 |
| 1174.65907 | 1179.24528 | D | 00 35 |
| 1244.50794 | 1250 | D# | 00 32 |
| 1318.51023 | 1329.78723 | E | 00 2F |
| 1396.91293 | 1388.88889 | F | 00 2D |
| 1479.97769 | 1488.09524 | F# | 00 2A |
| 1567.98175 | 1562.5 | G | 00 28 |
| 1661.21879 | 1644.73684 | G# | 00 26 |
| 1760 | 1736.11111 | A | 00 24 |
| 1864.65505 | 1838.23529 | A# | 00 22 |
| 1975.53321 | 1953.125 | B | 00 20 |
| 2093.00452 | 2083.33333 | C | 00 1E |
| 2217.46105 | 2232.14286 | C# | 00 1C |
| 2349.31815 | 2314.81482 | D | 00 1B |
| 2489.01587 | 2500 | D# | 00 19 |
| 2637.02046 | 2604.16667 | E | 00 18 |
| 2793.82586 | 2840.90909 | F | 00 16 |
| 2959.95539 | 2976.19048 | F# | 00 15 |
| 3135.96349 | 3125 | G | 00 14 |
| 3322.43759 | 3289.47369 | G# | 00 13 |
| 3520 | 3472.22222 | A | 00 12 |
| 3729.31009 | 3676.47059 | A# | 00 11 |
| 3951.06641 | 3906.25 | B | 00 10 |

*Table 1. Register load values to produce a frequency based on the even tempered scale.*

on the slot to change state and, in effect, turn on the slot. The controlling program is written to use slot 3.

Writing to any addresses from $C300 through $C3FF will cause pin 1 on the slot to go low for 500 ns. This pin is tied to one of the chip select lines on each PIA. During this time, data is accepted by the PIAs from the Apple. This data is then further directed to one of the PSG's address/data lines.

The only other integrated circuit I used besides the PIA's and the PSG's was a 74LS14 hex inverter. This is needed to buffer the reset line and invert the clock lines from the I/O slot. You should do this since these two lines have to each drive four other inputs on the circuit board.

The address lines and data lines on the PSG are common to each other. By use of two control lines, addresses and data can be latched into the PSG. Actually, of three control lines on the PSG, only two are needed. To write data to the PSG, the address of the register to be written must first be presented on the address/data lines. The address is then latched into the PSG. Then data for the desired register is presented on the address/data lines. Finally, the data is latched into the PSG.

The program listing is explained in Table 2.

| | |
|---|---|
| 1250–1340 | Set up PIAs (explained in text). |
| 1380–1420 | The note codes will start at location $2000. |
| 1430–1470 | Save the tempo bytes located at $2000–2001. |
| 1540–1870 | Check for control bytes. |
| | $F1—Directs the program to load the PSG connected to the right channel. |
| | $F2—Left channel. |
| | $FE—End of song. Reconnects DOS. |
| | $FF—Delay a predetermined length of time while the PSGs are playing a note or chord. |
| 1900–1910 | The program is directed to load the PSG connected to the right or left channel. |
| 1950–1990 | Latch the address for the desired register into the PSG (right channel). |
| 2030–2090 | Latch the data into the selected address of the PSG (right channel). |
| 2110–2260 | Same as lines 1950 through 2090 except the PSG connected to the left channel is loaded. |
| 2310–2360 | Load the next byte from memory into the accumulator. |

*Table 2. Annotations for the program listing.*

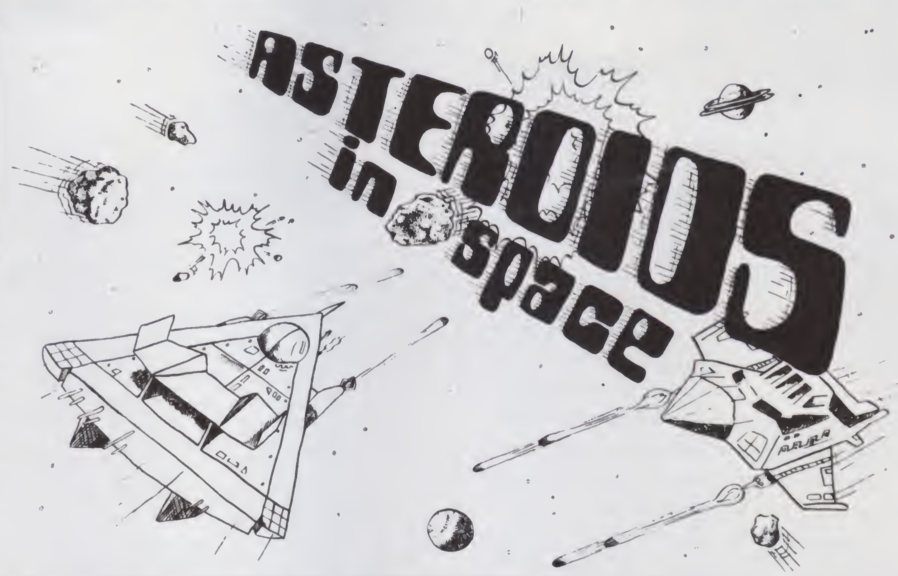
### Using an Assembler

Typing hex values directly into the Apple memory via the monitor is convenient until a change or insertion is required. This is why I strongly recommend the use of an assembler. I use the S-C Assembler II from S-C Software, PO Box 5537, Richardson, TX 75080. This assembler lets you edit hex strings as easily as a BASIC program. These strings of hex data can as easily be saved to disk or cassette tape.

### Programming the PSG

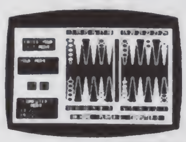
A partial listing of the codes for the first few measures of "The Maple Leaf Rag" by Scott Joplin is shown in Table 3. The control

# Software for the Apple II and Apple II Plus*


**ASTEROIDS IN SPACE™**
By Bruce Wallace
An exciting space action game! Your space ship is traveling in the middle of a shower of asteroids. Blast the asteroids with lasers, but beware — big asteroids fragment into small asteroids! The Apple game paddles allow you to rotate your space ship, fire its laser gun, and give it thrust to propel it through endless space. From time to time you will encounter an alien space ship whose mission is to destroy you, so you'd better destroy it first! High resolution graphics and sound effects add to the arcade like excitement that this program generates. Runs on any Apple II with at least 32K of RAM and one disk drive.

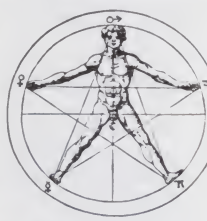
**On Diskette - $19.95**



**FASTGAMMON™** By Bob Christiansen.
Sound, hi res, color, and musical cartoons have helped make this the most popular backgammon playing game for the Apple II. But don't let these entertaining features fool you — FASTGAMMON plays serious backgammon. Runs on any Apple II with at least 24K of RAM.

**Cassette - $19.95 Diskette - $24.95**

**ASTROAPPLE™** by Bob Male.
Your Apple computer becomes your astrologer, generating horoscopes and forecasts based on the computed positions of the heavenly bodies. This program offers a delightful and stimulating way to entertain friends. ASTROAPPLE produces natal horoscopes (birth charts) for each person based on his or her birth data. Any two people may be compared for physical, emotional, and intellectual compatibility. The program is written in Applesoft BASIC with machine language subroutines. It requires either RAM or ROM Applesoft and at least 32K of memory.



**Cassette - $14.95 Diskette - $19.95**

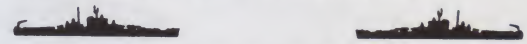

**FRACAS™** by Stuart Smith.
A fantastic adventure game like no other! Up to eight players can participate in FRACAS at the same time. Journey in the land of FAROPH, searching for hidden treasure while warding off all sorts of unfriendly and dangerous creatures. You and your friends can compete with each other or you can join forces and gang up on the monsters. Your location is presented graphically and sound effects enliven the battles. Save your adventure on diskette or cassette and continue it at some other time. Both integer BASIC and Applesoft versions included. Requires at least 32K of RAM.

**Cassette - $19.95 Diskette - $24.95**

**BENEATH APPLE MANOR™** by Don Worth.
Descend beneath Apple Manor into an underground maze of corridors, rooms, and secret passages in quest of rich and powerful treasures. The dungeon complex consists of many floors, each lower level more dangerous than the last. If you can reach the lowest level, you may even find the ultimate object of your quest, the fabled golden apple of Apple Manor. Strategy is extremely important as you deal with a variety of monsters, each with its own characteristics. Written in integer BASIC with machine language subroutines. Requires integer BASIC and at least 16K of RAM on cassette or 32K of RAM on diskette.

**Cassette - $14.95 Diskette - $19.95**

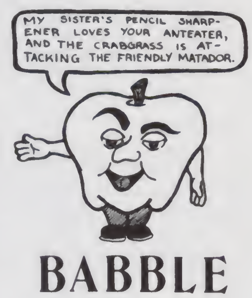
**BATTLESHIP COMMANDER™** by Erik Kilk and Matthew Jew.



A game of strategy. You and the computer each start out by positioning five ships of different sizes on a ten by ten grid. Then the shooting starts. Place your volleys skillfully — a combination of logic and luck are required to beat the computer. Cartoons show the ships sinking and announce the winner. Sound effects and flashing lights also add to the enjoyment of the game. Both Applesoft and integer BASIC versions are included. Requires at least 32K of RAM.

**Cassette - $14.95 Diskette - $19.95**

**BABBLE™** by Don Worth.
Have fun with this unique software. You write a story, entering it as a BABBLE program. As you write the story you specify certain words to be selected by the computer or entered from the keyboard at execution time. Run the program and watch BABBLE convert your story into an often hilarious collection of incongruities. The ways in which BABBLE can entertain you are limited only to your imagination. You can compose an impressive political speech or write poetry. You can plan a dinner menu. You can even form images on the screen or compose musical tunes with the help of BABBLE. The cassette version requires at least 16K of RAM and the diskette version requires at least 32K of RAM. BABBLE is written in machine language and runs on any Apple II computer.




**Cassette - $19.95 Diskette - $24.95**

L I N K E R

**LINKER** by Don Worth.
Turn your Apple II or Apple II Plus into a powerful and productive software development machine with this superb linking loader/editor package. LINKER does the following and much more:

- Dynamically loads and relocates suitably prepared machine language programs anywhere in RAM.
- Combines a main program with subroutines. You can assemble a subroutine once and then use it with as many main programs as you wish.
- Produces a map of all loaded routines, giving their location and the total length of the resulting module.
- Contains a library of subroutines including binary multiplication and division, print text strings, delay, tone generator, and random number generator.

Linker works with virtually any assembler for the Apple II. Requires 32K of RAM and one disk *drive*.

**Diskette - $49.95**
**Manual Only - $19.95**

QS QUALITY SOFTWARE
6660 Reseda Blvd., Suite 105, Reseda, CA 91335
(213) 344-6599

Now exclusive distributors for products from The Software Factory, Newhall, California
*Apple II and Apple II Plus are trademarks of Apple Computer, Inc.

**WHERE TO GET IT:** Call us at (213) 344-6599 for the name of the Quality Software dealer nearest you. If necessary you may order directly from us. Mastercard and Visa cardholders may order by telephone. Or mail your check or bankcard number to Quality Software, 6660 Reseda Blvd., Suite 105, Reseda, CA 91335. California residents add 6% sales tax. SHIPPING CHARGES: Within North America orders must include $1.50 for first class shipping and handling. Outside North America the charge for airmail shipping and handling is $5.00. Pay in U.S. currency.

program resides in locations $800 to $8B4. The codes for the notes start at location $2000. The first two bytes of the codes are used to set the tempo of the music. The lower the value of these bytes, the faster the music will be played. Some of the codes are explained in Table 4.

### Special Sound Effects

Within the music portion of the PSG, some very interesting sounds other than square waves may be produced. For example, loading a tone register with $8E will produce a frequency of 440 Hz. If another tone register is at the same time loaded with $8D, a frequency of slightly higher than 440 Hz will be produced. When these two frequencies are combined, a wave form with a varying duty cycle is generated. The effect is quite interesting. If two tone registers are loaded with the same value, the combined frequencies, although the same, do not start playing at the same time. The result is a frequency with a duty cycle less than 50 percent.

### I/O Registers on the PSG

Although not used in this music program, two other useful registers are in the PSG. These are two general-purpose eight-bit parallel I/O ports. These ports are controlled via registers E and F by setting bits B6 and B7 in register 7. For example, to set I/O port A to an input port and I/O port B to an output port, set bit B6 and B7 in register 7 to an I and O, respectively.

### Construction

The entire circuit, except the amplifier, is wired on the Apple II prototyping board (see photographs and Fig. 2). The actual wiring took me less than four hours. I used integrated circuit sockets to avoid damaging the integrated circuits due to static electricity or heat from soldering. I wired a few .01 uF capacitors between the 5-volt and ground bus.

Although I purchased an amplifier, you can build one using inexpensive components. One section of the PSG data manual shows how to do this with a commercially available LM386 audio amplifier. Cost for all parts, except the amplifier and speakers, is under $50. ■

```
00 49 F1 07 38 08 10 09 10 0A 10 0C 0A F2 07 38 08 10 09 10
0A 10 0C 08 F2 00 92 01 01 02 24 03 03 0D 09 FF FF 00 2D 02
5A 03 02 0D 09 FF F1 00 96 0D 09 FF F2 00 EF 01 00 02 2D 03
01 04 92 05 01 0D 09 F1 00 64 02 C9 0D 09 FF 00 96 02 00 0D
09 FF F2 0D 09 F1 00 77 0D 09 FF 00 64 02 C9 0D 09 FF F2 00
1C 01 01 02 38 03 02 04 00 05 00 0D 09 FF F1 00 9F 02 00 0D
09 FF F1 00 64 02 C9 0D 09 F2 00 0C 01 01 02 18 03 02 0D 09
FF F1 00 9F 02 00 0D 09 FF F2 00 E1 01 00 02 3F 03 01 04 92
05 01 0D 09 F1 00 86 0D 09 FF 00 64 02 C9 0D 09 FF F2 0D 09
FF FF 00 92 01 01 02 24 03 03 04 00 05 00 0D 09 FF FF F1 00
00 02 00 F2 00 2D 02 5A 03 02 0D 09 FF F1 00 96 0D 09 FF F2
00 EF 01 00 02 2D 03 01 04 92 05 01 0D 09 F1 00 64 02 C9 0D
09 FF 00 96 02 00 0D 09 FF F2 0D 09 F1 00 77 0D 09 FF 00 64
02 C9 0D 09 FF F2 00 1C 01 01 02 38 03 02 04 00 05 00 0D 09
FF F1 00 9F 02 00 0D 09 FF F1 00 64 02 C9 0D 09 F2 00 0C 01
01 02 18 03 02 0D 09 FF F1 00 9F 02 00 0D 09 FF F2 00 E1 01
00 02 3F 03 01 04 92 05 01 0D 09 F1 00 86 0D 09 FF 00 64 02
C9 0D 09 FF F2 0D 09 FF FF 00 92 01 01 02 24 03 03 04 00 05
00 0D 09 FF F1 0D 09 FF 02 00 F2 00 7B 01 01 02 F6 03 02 0D
09 FF F1 00 96 0D 09 FF 00 7F 0D 09 FF 00 5F 02 BE 0D 09 FF
F2 00 92 01 01 02 24 03 03 0D 09 FF F1 00 64 02 C9 0D 09 FF
F2 0D 09 FF F1 0D 09 FF F2 00 7B 01 01 02 F6 03 02 0D 09 F1
00 00 02 00 FF F1 00 96 0D 09 FF 00 7F 0D 09 FF 00 5F 02 BE
0D 09 FF F2 00 92 01 01 02 24 03 03 0D 09 FF F1 00 64 02 C9
0D 09 FF FF FF
```

*Table 3. Note and control codes to play the first seven measures of "The Maple Leaf Rag" by Scott Joplin.*

| | |
|---|---|
| 0049 | Set up tempo. |
| F1 | Set program to right channel. |
| 0738 | Load register 7 to enable all tones on channels A, B and C. |
| 0810 | Load register 8 to enable the envelope generator for channel A. |
| 0910 | Load register 9 same as register 8. |
| 0A10 | Load register A same as register 8. |
| 0C0A | Load register C with the decay rate. |
| F2 | Set program to left channel. |
| 0738 | Load register 7 to enable all tones on channels A, B and C. |
| 0810 | |
| 0910 | |
| 0A10 | Same as for right channel except the decay rate as set by register C will be |
| 0C08 | slightly faster in the left channel. |
| 0092 | |
| 0101 | Loads registers 0 and 1 with the value 0192 for the note D#. |
| 0224 | |
| 0303 | Loads registers 2 and 3 with the value 0324 for the note D# an octave lower. |
| 0D09 | Load register D with the hex value 09. This will cause the PSG to play the note with a sharp attack and a slow decay. |
| FFFF | Causes the program to wait while the note is being played. Each FF code will cause the program to wait a time period controlled by tempo bytes in location 2000-2001. |

*Table 4. Annotations for the codes for "The Maple Leaf Rag" (see Table 3).*

*Music Generation program.*

```
1000 *
1010 *   MUSIC GENERATION PROGRAM
1020 *
1030 *  FOR PROGRAMMABLE SOUND GENERATOR
1040 *
1050 *       R. R. URSCHEL   REV. 2-28-80
1060 *
1080 *
1090        .OR $800
1100 MEML   .EQ $00
1110 MEMH   .EQ $01
1120 WAITL  .EQ $02     TIME DELAY BETWEEN NOTES
1130 WAITH  .EQ $03
1140 SWAITL .EQ $04   SAVE TIME DELAY
```

```
                SWAITH .EQ $05
                CHAN   .EQ $06  0=RIGHT  1=LEFT
                DATA1  .EQ $C30C   PERIPHERAL
                BUS1   .EQ $C30E     SLOT
                DATA2  .EQ $C330      ADDRESSES
                BUS2   .EQ $C332
                **************************
                *
                *  SET UP PIA'S
                *
0800- A9 FF             LDA #$FF   SET THE DDR
0802- 8D 0C C3          STA $C30C  A SIDE OUTPUTS
0805- 8D 30 C3          STA $C330
0808- 8D 0E C3          STA $C30E  B SIDE OUTPUTS
080B- 8D 32 C3          STA $C332
080E- A9 04             LDA #$04   SET BIT 2 OF THE CONTROL REGISTER
0810- 8D 0D C3          STA $C30D
0813- 8D 0F C3          STA $C30F
0816- 8D 31 C3          STA $C331
0819- 8D 33 C3          STA $C333
                *
                *  INITIALIZE NOTE TABLE
                *
081C- A0 00     INIT    LDY #$00
081E- 84 06             STY CHAN
0820- 84 00             STY MEML
0822- A9 20             LDA #$20   NOTES START AT $2000
0824- 85 01             STA MEMH
                *
                *  FIRST TWO BYTES SET TEMPO
                *
0826- B1 00             LDA (MEML),Y
0828- 85 04             STA SWAITL
082A- C8                INY
082B- B1 00             LDA (MEML),Y
082D- 85 05             STA SWAITH
                *
                *********************************
                *********************************
                *
                *  START LOADING REGISTERS
                *
082F- 20 AA 08  LOADR   JSR GET
0832- C9 FF             CMP #$FF
0834- D0 13             BNE CKDONE
                * IF BYTE = $FF
                * END OF REGISTER LOADS. WAIT WHILE PLAYING NOTES
                *
0836- A5 04             LDA SWAITL
0838- 85 02             STA WAITL
083A- A5 05             LDA SWAITH
083C- 85 03             STA WAITH
083E- C6 02     DELY1   DEC WAITL
0840- D0 FC             BNE DELY1
0842- C6 03             DEC WAITH
0844- D0 F8             BNE DELY1
0846- 4C 2F 08          JMP LOADR   GET NEXT BYTE VALUE
                *
                * IF A = FE THEN END OF SONG
0849- C9 FE     CKDONE  CMP #$FE
084B- D0 03             BNE CKA
084D- 4C D0 03          JMP $3D0
                *
                * IF A = F1 THEN SET RIGHT CHANNEL
0850- C9 F1     CKA     CMP #$F1
0852- D0 07             BNE CKB
0854- A9 00             LDA #$00
0856- 85 06             STA CHAN
0858- 4C 2F 08          JMP LOADR
                *
                * IF A = F2 THEN SET LEFT CHANNEL
085B- C9 F2     CKB     CMP #$F2
085D- D0 07             BNE LOAD
085F- A9 01             LDA #$01
0861- 85 06             STA CHAN
0863- 4C 2F 08          JMP LOADR
                *
                *
0866- A6 06     LOAD    LDX CHAN
0868- D0 20             BNE LATCHB
                ******************************
                *  LATCH ADDRESS FOR RIGHT CHANNEL
                *
086A- A2 05             LDX #$05
086C- 8E 0E C3          STX BUS1
086F- 8D 0C C3          STA DATA1  FORM ADDRESS
0872- A2 00             LDX #$00
0874- 8E 0E C3          STX BUS1  LATCH ADDRESS
                *
                *  GET VALUE AND LATCH DATA
                *
0877- 20 AA 08          JSR GET
087A- 8D 0C C3          STA DATA1   FORM DATA
087D- A2 06             LDX #$06
087F- 8E 0E C3          STX BUS1
```

```
0882- A2 00     2070         LDX #$00
0884- 8E 0E C3  2080         STX BUS1    LATCH DATA
0887- 4C 2F 08  2090         JMP LOADR
                2100 ******************************
                2110 *  LATCH ADDRESS FOR LEFT CHANNEL
088A- A2 05     2120 LATCHB  LDX #$05
088C- 8E 32 C3  2130         STX BUS2
088F- 8D 30 C3  2140         STA DATA2   FORM ADDRESS
0892- A2 00     2150         LDX #$00
0894- 8E 32 C3  2160         STX BUS2  LATCH ADDRESS
                2170 *
                2180 * GET VALUE AND LATCH DATA
                2190 *
0897- 20 AA 08  2200         JSR GET
089A- 8D 30 C3  2210         STA DATA2    FORM DATA
089D- A2 06     2220         LDX #$06
089F- 8E 32 C3  2230         STX BUS2
08A2- A2 00     2240         LDX #$00
08A4- 8E 32 C3  2250         STX BUS2  LATCH DATA
08A7- 4C 2F 08  2260         JMP LOADR
                2270 *
                2280 ******************************
                2290 *  GET NEXT BYTE FROM MEMORY
                2300 *
08AA- C8        2310 GET     INY
08AB- F0 03     2320         BEQ ADJHI
08AD- B1 00     2330 LOADA   LDA (MEML),Y
08AF- 60        2340         RTS
08B0- E6 01     2350 ADJHI   INC MEMH
08B2- 4C AD 08  2360         JMP LOADA
                2370 *
                2380 *


SYMBOL TABLE

MEML    0000   MEMH    0001   WAITL   0002
WAITH   0003   SWAITL  0004   SWAITH  0005
CHAN    0006   DATA1   C30C   BUS1    C30E
DATA2   C330   BUS2    C332   INIT    081C
LOADR   082F   DELY1   083E   CKDONE  0849
CKA     0850   CKB     085B   LOAD    0866
LATCHB  088A   GET     08AA   LOADA   08AD
ADJHI   08B0
```

# Computerized Project Management

*This program for the Apple II helps you plan and schedule complex projects; book publishing is used as an example.*


*Derek A. Kelly*
*832 Lafayette St.*
*Denver, CO 80218*


While planning won't assure success, it can help prevent massive failure. A good computer program can implement a planned approach to any business project.

In this case, the project is a book publishing enterprise. I developed the program on an Apple II microcomputer, using Apple's Applesoft II floating point BASIC.

### Structured Project Design

You can structure a project by dividing it into two basic parts: where the project's activities will take place (the arena) and what the activities are that will lead to the project's completion (Fig. 1).

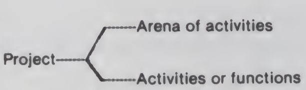



*Fig. 1. Project structure.*

These areas can be further divided. When studying the location, you need to know what the immobile spaces for the project activities are, what the mobile spaces, such as transportation means, are and how many people will be needed to perform the activities.

A study of the project's activities should cover four areas: the problem the project is designed to solve, such as filling an information gap in a given market; the design of the entire project and the end result, or product, of the project; construction of the product; and distribution of the product (Fig. 2).

A complete flowchart of these divisions should show the sequence of functions in dynamic interaction with each other, with many feedback loops.

### The Program

To make a sound decision on the feasibility of a publishing project, you need to calculate as correctly as possible the probable expenses connected with each phase of the project. The Book Project Management program was designed specifically to help with such calculations.

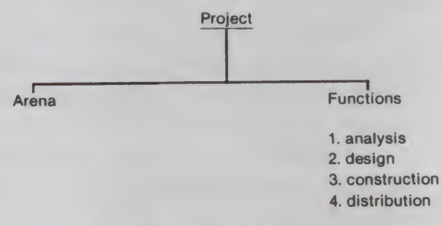



*Fig. 2. Project's activities.*

The program reads a list of accounts connected with the project, requests user input of costs, keeps a running tally of expenses and prints out totals for both individual accounts and accounts belonging to each phase. It lets decision-makers realistically figure the expenses of a project.

Depending on how ambitious or detailed you want to be, the program can handle up to 800 accounts (though only 35 accounts are included in the present program). To increase or modify the accounts, you need to change only the data statements and number, and perhaps the dimensions of the variables bunched together at the start of the main program on lines 500–599.

The 35 accounts are organized to follow the project divisions noted earlier. Accounts are concerned with either the arena (100–499) or the functions (500–899). These two areas are further subdivided to reflect the four functional phases of the project, leaving 100 possible accounts for each phase within each basic division (arena-function).

The program will print out information on each account sequentially or randomly, and will also request that expenses and time calculations be input so that the "man-days" of the project can be calculated. The

Program Procedures and Options

1. LOAD. RUN.
2. Input date.
3. Input budget (this can be changed over and over).
4. Choice of list of accounts/no list. Accounts listed sequentially by hitting any key but RETURN. Hit RETURN to abort the listing.
5. Choice between random and sequential inputs. Main MENU: (1) random input, (2) sequential input, (3) traffic control. The sequence for both inputs is: Hit '0' for reports; '1' for traffic control; or enter account number if random input, or accounts sequentially; Input cost and time estimates; a progressive summary printed out after each entry.
6. Reports:
   a. Individual reports (hit RETURN to abort).
   b. Summary reports.
   c. Office (arena/space) reports for each phase of project.
   d. Function reports.
   e. Combined office/function reports.
   f. Note: Ongoing costs calculated at 10 percent.

*Table 1. Program procedures and options.*

computer provides a running summary after each input. At the end of all inputs, it reports on individual accounts, arena accounts and function accounts and prints out a combined report.

The random input subroutine allows "infinite" modifications of inputs to accounts so that improvements in calculated expenses can be made after the first step through the accounts. You can thus calculate and modify costs over and over again until some realistic assessment of expenses and budgetary limitations can be made.

Also, many expenses of an unplanned project are hidden, and making these costs explicit and calculable can help you to anticipate potential problems.

The program is a little under 7K long as listed, and will run in 3 to 5K. Written in Applesoft II, it will run in a 16K Apple if Applesoft is in ROM or in a 24K system if Applesoft is on cassette.

The program includes subroutines to turn a Centronics microprinter on and off by using slot 6 on the Apple. These can be changed to fit any kind of printer and are located on lines 60–65 (on) and 70–74 (off). If you don't want hard copy, the program is designed so that these routines need not be called.

However, if you don't have a printer, a mistaken call to a printer will cause the system to hang and cause loss of all data inputs. You may therefore want to change the printer on/off routines so that they list as REMs, leaving the Return as it is. This way, even if a call is mistakenly made for a hardcopy printout, nothing will happen and the system won't hang.

While I had to resort to a few of those GOTOs so abhorrent to structured programmers, I am happy that the ratio of GOSUBs to GOTOs is about 100 to 1.

On RUN, the program will request user input of the date and project budget. If you desire, it will then print out each account. A simple FOR-NEXT loop is used to slow the printing of these items, though a GET AN$ could also be used. Following that, you can execute a sequential input to the accounts or a random input by inputting the account number desired.

On each input request, sequential or random, you may call for a calculation subroutine to determine costs and can make multiple (dimensioned at 20) inputs to each account. After all sequential inputs have been made, reports can be printed out, or additional random-input-only inputs can be made. The reports can be printed out after each random input.

### Some User Modifications

Since the program is constructed mainly out of subroutines that mostly occur between lines 7 and 199 of the program, you can easily add or subtract aspects of the program by adding or deleting calls to these subroutines.

The main program begins at line 500. It's reached via a GOTO from line 3. I first used a GOSUB, switching to a GOTO after I realized the program never returns to line 3. The main program calls subroutines in the main input subroutine starting on line 300. This input GOSUB calls on subroutines that are on lines 7–199, though one or two GOSUBs are in the program later, such as the printing routine starting on line 600. The

*Program listing. Publishing program in Applesoft BASIC.*

```
]LIST
1  REM  BY DEREK KELLY--'STRUCTURED PROJECT MANAGEMENT FOR A SMALL PUBLISH
   ER'
2  REM PUB. KILOBAUD MICROCOMPUTING
3  GOTO 500
4 ::
7 TT = TT + EE(J): RETURN
9 ::
11  FOR A = 1 TO 20: PRINT "<>";: NEXT A: RETURN
12  FOR A = 1 TO 40: PRINT "=";: NEXT A: RETURN
14  FOR A = 1 TO 40: PRINT "+";: NEXT A: RETURN
16  PRINT  TAB( 30)"KEY!";: GET A$: RETURN
17  FOR A = 1 TO 40: PRINT "↑";: NEXT A: RETURN
19 ::
20  REM --FORMULAE
21  PRINT
22  PRINT "COST/WAGE.*.ITEM/TIME=EXPENSE"
23  INPUT "CW/IT";C,W
25  PRINT
27 IT = C * W: PRINT "$";IT
28  RETURN
29 ::
30 OT = OT + EE(J): RETURN
32 PT = PT + EE(J): RETURN
33 ::
34 AO = AO + EE(J): RETURN
36 DO = DO + EE(J): RETURN
38 PO = PO + EE(J): RETURN
40 DE = DE + EE(J): RETURN
41 ::
42 AP = AP + EE(J): RETURN
44 DP = DP + EE(J): RETURN
46 PP = PP + EE(J): RETURN
48 DD = DD + EE(J): RETURN
49 ::
50  FOR A = 10 TO 35: PRINT  TAB( A)"↑";: NEXT A: RETURN
52 ::
60  REM PRINTER ON/OFF
61  VTAB (5): PRINT "#1-MONITOR:#2-PRINTER:"
62  INPUT "#:";Q
63  IF  STR$ (Q) =  CHR$ (13) THEN 65
64  IF Q = 1 THEN  GOSUB 70
65  RETURN
66 ::
70  REM POKE54,0:POKE55,198
71  REM  PRINT 'CNTRL I-K'
72  REM PRINT'CNTRL I-80-N'
74  RETURN
75 ::
76  REM POKE54,240:POKE55,253
77  RETURN
78 ::
80  REM  INDIV REPORT PRINT OUTS
81  HOME
82  GOSUB 260
84  FOR J = 1 TO N
85  GOSUB 280
86  GOSUB 104
88  FOR A = 1 TO 1000: NEXT A
89  GOSUB 16: IF A$ = "0" THEN 92
90  PRINT : NEXT J
92  RETURN
93 ::
94  PRINT  TAB( 4)"ANALYSIS PHASE:$";: RETURN
95  PRINT  TAB( 4)"DESIGN PHASE:$";: RETURN
96  PRINT  TAB( 4)"PRODUCTION PHASE:$";: RETURN
97  PRINT  TAB( 4)"DISTRIBUTION PHASE:$";: RETURN
99 ::
100  REM  GOSUBALLEY
101  GOSUB 12
102  GOSUB 280
104  PRINT "ACCOUNT #:";N%(J)
105  PRINT "      NAME:";N$(J)
106  PRINT "      TYPE:";SF$(J)
107  PRINT "     PHASE:";PH$(J)
108  PRINT "      TIME:";: PRINT "DAYS:";DV(J)
109  PRINT "EXPENSES :";EE(J)
111  GOSUB 12
113  RETURN
114 ::
```

subroutines between lines 7 and 99 are mainly one-line GOSUBs that do the addition of inputs, while the subroutines between lines 100 and 199 are generally longer.

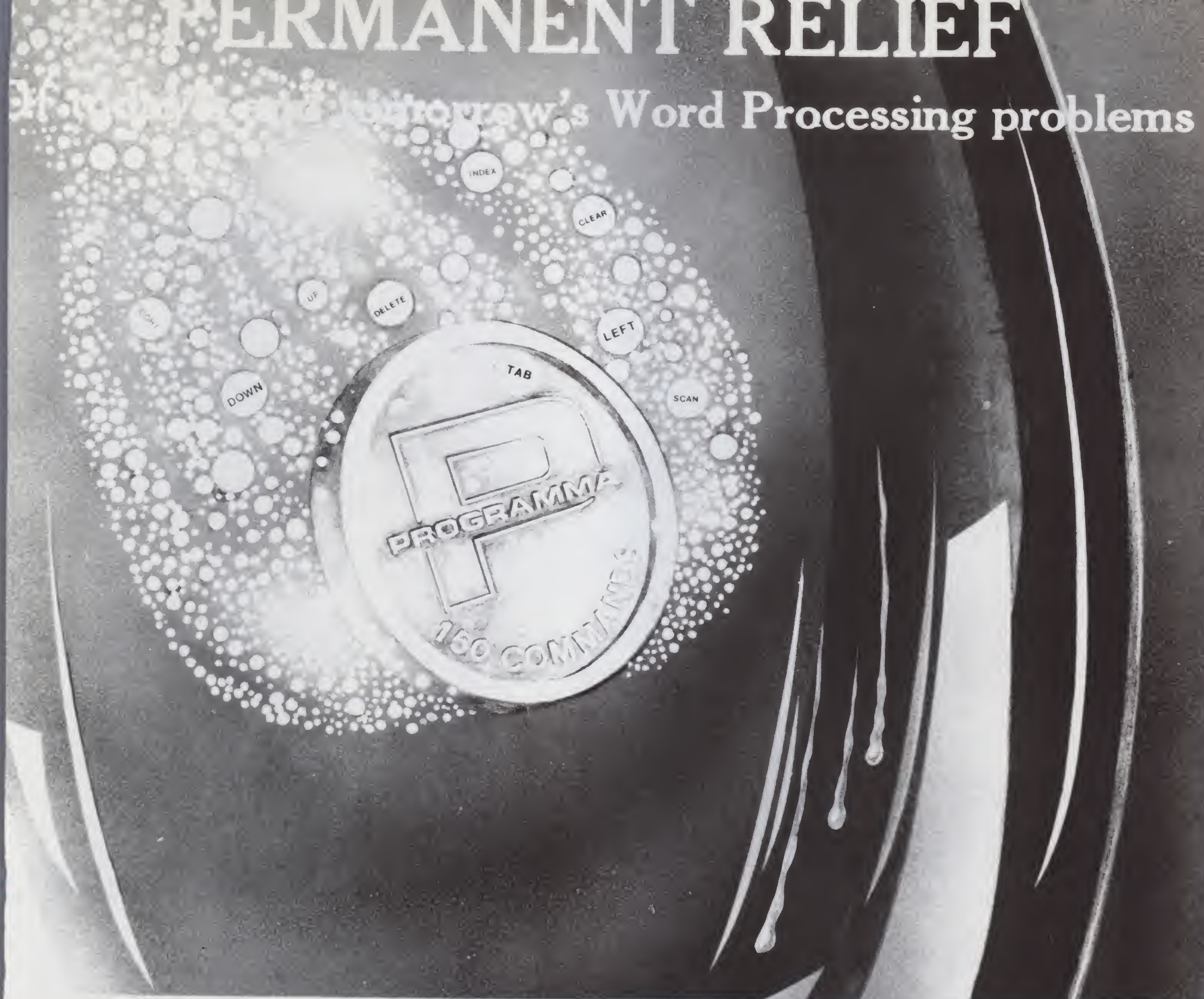
At the start of the main program, all the main variables are listed and dimensioned. You can modify these dimensions all at once without searching through the whole program.

Data statements on the accounts begin on line 200. You can add to these accounts at will following the order noted in the REM there, and need only change the number of the accounts to assure satisfactory running of the program.

The report printouts include a routine to print out ongoing or continuing costs of a project. In this program, that ongoing amount is ten percent of the entire project cost. You can modify this amount by changing lines 662 and 692. ■



```
115  REM  TO INPUT ACC'T
116 AN = 0:JE = 0
118  PRINT "# OF INPUTS TO THIS ACCOUNT?"
119  INPUT "#:";Z
120  IF Z = 0 OR  STR$ (Z) =  CHR$ (13) THEN 130
121  FOR K = 1 TO Z
122  INPUT "(ENTER '1' TO CALCULATE)";CC
124  IF CC = 1 THEN  GOSUB 22
125  PRINT "INPUT #";K;"=";
126  INPUT "INPUT $";AN(K)
127  IF AN(K) =  - 1 THEN 116
128 JE = JE + AN(K)
129  NEXT K
130 EE(J) = JE
131  GOSUB 7
132 IN = IN + Z
133  RETURN
134 ::
135  PRINT "TIME TO DO THIS JOB?=";
137  INPUT DV(J)
138  RETURN
139 ::
140  REM  TALLYING
145  IF SF$(J) = "OFFICE" THEN  GOSUB 30
147  IF SF$(J) = "PROCESS" THEN  GOSUB 32
149  RETURN
150 ::
151  REM  GOSUB TO TALLY
153  IF N%(J) =  > 100 AND N%(J) <  = 199 THEN  GOSUB 34
154  IF N%(J) =  > 200 AND N%(J) <  = 299 THEN  GOSUB 36
155  IF N%(J) =  > 300 AND N%(J) <  = 399 THEN  GOSUB 38
156  IF N%(J) =  > 400 AND N%(J) <  = 499 THEN  GOSUB 40
158  IF N%(J) =  > 500 AND N%(J) <  = 599 THEN  GOSUB 42
159  IF N%(J) =  > 600 AND N%(J) <  = 699 THEN  GOSUB 44
160  IF N%(J) =  > 700 AND N%(J) <  = 799 THEN  GOSUB 46
161  IF N%(J) =  > 800 AND N%(J) <  = 899 THEN  GOSUB 48
163  RETURN
164 ::
165  REM GOSUB TO TALLY UP TIME
166 DX = DX + DV(J)
167 D1 = DX:M1 = D1 / 30:Y1 = D1 / 365
168  RETURN
169 ::
170  REM  STEP BY STEP TALLY
171  GOSUB 12: PRINT  TAB( 10)"PROGRESSIVE SUMMARY"
172  GOSUB 50: PRINT
173  PRINT  TAB( 10)"BUDGET=$";PB: PRINT  TAB( 10)"EXPENSES TO HERE:$";TT
174  PRINT  TAB( 10)"BUDGET REMAINDER=$";PB - TT
175  PRINT  TAB( 10)"WORK TIME TO HERE::": PRINT  TAB( 12)"-TOTAL DAYS=";D
     1
176  PRINT  TAB( 12)"-TOTAL MONTHS=";M1
177  PRINT  TAB( 12)"-TOTAL YEARS=";Y1
178  GOSUB 50: PRINT
179  RETURN
180 ::
200  DATA 35: REM  ACCOUNTS
201  REM  ORDER=KIND,DESCRIPTION,#,NAME
203 ::
204  DATA OF,AN,101,EQUIPMENT
205  DATA OF,AN,103,INSURANCE
206  DATA OF,AN,105,CLERICAL
207 ::
210  DATA OF,DE,201,SECRETARIAL
211  DATA OF,DE,203,ADMINISTRATION
212  DATA OF,DE,205,ENERGY
213  DATA OF,DE,207,TELEPHONE
214 ::
216  DATA OF,PR,301,COPY EDIT
217  DATA OF,PR,303,SUPPLIES
218  DATA OF,PR,305,CONTINGENCY
219 ::
220  DATA OF,DI,401,AD-CONSTRUCTION
221  DATA OF,DI,403,ACCOUNTING
222  DATA OF,DI,405,BILLING
223  DATA OF,DI,407,MAILING
224  DATA OF,DI,409,COMMUNICATIONS
225  DATA OF,DI,411,PUBLICITY(ADS)
226  REM -------------------------
230  DATA PRO,AN,501,MEETINGS
231  DATA PRO,AN,503,RESEARCH
232  DATA PRO,AN,505,PLANNING
233  DATA PRO,AN,507,CONSULTING
234 ::
235  DATA PRO,DE,601,MOCKUPS
236  DATA PRO,DE,603,TRAVEL
237  DATA PRO,DE,605,COMMUNICATIONS
238  DATA PRO,DE,607,RIGHTS
239 ::
240  DATA PRO,PR,701,CONTENTS
241  DATA PRO,PR,703,WRITTEN CONTENT
242  DATA PRO,PR,705,LEGAL
243  DATA PRO,PR,707,TYPING
244  DATA PRO,PR,709,PROOFREADING
245  DATA PRO,PR,711,PRINTING
246 ::
248  DATA PRO,DI,801,ONGOING-ADS
```




## Apple PIE + Formatter

Apple PIE (Programma International Editor) d FORMAT (text formatter) offer full strength utions to today's word processing problems. ese versatile, powerful programs provide cument preparation and word processing pabilities previously found only on much larger mputer systems.

*PIE* is a general purpose, full screen editor t uses control keys and function buttons to vide a full range of editing capabilities such as rch and replace, delete, copy, insert, move. anges may be made directly anywhere on the een and are shown as they are performed.

FORMAT uses simple instructions bedded in the input text to describe the desired earance of the final document. It handles tering, underlining, indenting, page numbering, margins, headers, footers, even form letters, and includes a proofing capability.

These high-quality, cost-effective programs come with comprehensive documentation and run on a 32K Apple II. They are available through your local computer store or direct from Programma International, Inc. at the introductory price of $79.95*.

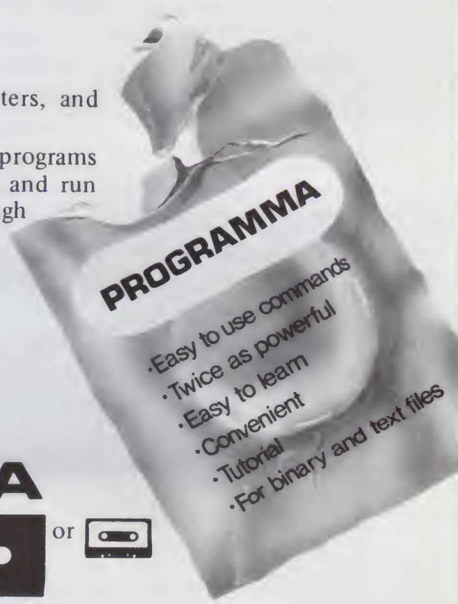
VIDEX VERSION T.M.
DOUBLE VISION T.M.
SUPR TERM VERSION T.M.
STANDARD VERSION

*December 1, $129.95.

✓11

**PROGRAMMA**
3400 Wilshire Boulevard
Los Angeles, California 90010
(213) 384-0579

or




**Simple enough for the beginner. Versatile enough for the professional.**

```
249  DATA PRO, DI, 803, MAILING
250  DATA PRO, DI, 805, MAILING-LISTS
251  DATA PRO, DI, 807, INVOICING
252  DATA PRO, DI, 809, FREE COPIES
253  DATA PRO, DI, 811, ADMINISTRATION
254 : :
256  REM  260-299 GOSUBS
260  REM READ DATA
261  RESTORE
262  READ N
263  FOR J = 1 TO N
264  READ SF$(J), PH$(J), N%(J), N$(J)
265  NEXT J
266  RETURN
268 : :
270  HOME : GOSUB 11: PRINT
271  PRINT  TAB( 7)"(HIT '0' ANYTIME TO QUIT)": GOSUB 17
272  FOR J = 1 TO N: GOSUB 280
273  PRINT N%(J)":"N$(J)"--"SF$(J)"--"PH$(J): PRINT : GOSUB 14
274  PRINT : GOSUB 16: PRINT : GOSUB 17
275  IF A$ = "0" THEN 278
276  PRINT : NEXT J
277  GOSUB 16
278  RETURN
279 : :
280  REM GOSUBTO CHECK MEANINGS
281  IF (SF$(J) = "OF") THEN SF$(J) = "OFFICE"
282  IF (SF$(J) = "PRO") THEN SF$(J) = "PROCESS"
283  IF (PH$(J) = "AN") THEN PH$(J) = "ANALYSIS"
284  IF (PH$(J) = "DE") THEN PH$(J) = "DESIGN"
285  IF (PH$(J) = "PR") THEN PH$(J) = "PRODUCTION"
286  IF (PH$(J) = "DI") THEN PH$(J) = "DISTRIBUTION"
288  RETURN
289 : :
290  REM GOSUB TO PREVENT LOSS OF DATA
291  PRINT : GOSUB 14: PRINT "DO YOU WANT TO END?"
292  INPUT "Y/N";A$
293  IF A$ = "Y" THEN  END
294  RETURN
295 : :
296 BP$ = "STRUCTURED PROJECT MANAGEMENT":PB$ = "FOR A SMALL PUBLISHER"
297  PRINT  TAB( (40 -  LEN (BP$)) / 2)BP$: PRINT  TAB( (40 -  LEN (PB$)) /
     2)PB$
298  RETURN
299 : :
300  REM STRUCT/FUNCTGOSUB
301  HOME : VTAB (5): GOSUB 12
302 ES$ = "'STRUCTURE-FUNCTION ESTIMATES'": PRINT  TAB( (40 -  LEN (ES$)) /
     2)ES$
303  PRINT : GOSUB 17
305  PRINT  TAB( 4)"DO YOU WANT A LIST OF ACCOUNTS?"
306  GOSUB 260: PRINT
307  HTAB (18): INPUT "Y/N";Y$
308  IF Y$ = "Y" THEN  GOSUB 270
309  HOME : GOSUB 12
310  PRINT  TAB( (40 -  LEN (ES$)) / 2)ES$
311  PRINT : GOSUB 14: PRINT  TAB( 8)"(ENTER '0' TO RETURN)"
312  PRINT  TAB( 10)"1. RANDOM INPUT:": PRINT  TAB( 10)"2. SEQUENTIAL INPU
     T"
313  INPUT "INPUT #:";RS
314  IF RS = 0 OR  STR$ (RS) =  CHR$ (13) THEN 326
315  IF RS =  > 3 THEN  GOTO 309
316  ON RS GOSUB 330, 365
317 : :
318  PRINT : GOSUB 12: PRINT "FORGOT SOME?"
319  INPUT "(1)INPUT:(2)REPORTS:";SR
320  IF SR = 1 THEN 309
321  IF SR = 0 OR SR =  > 3 THEN  GOSUB 527
322  ON SR GOSUB 330, 600
324  GOSUB 527
326  RETURN
329 : :
330  REM  RANDOM INPUT
331  HOME : PRINT : VTAB (2): GOSUB 14
332 RI$ = "RANDOM INPUT:": PRINT  TAB( 13)RI$: PRINT  TAB( 11)"..........
     ...."
333  PRINT  TAB( 4)"('0' FOR REPORTS: '1' FOR MENU)"
334  PRINT  TAB( 8)"WHAT ACCOUNT # WANTED?";: INPUT WH
336  IF WH = 1 THEN  GOSUB 527
337  IF WH = 0 THEN  GOSUB 600
339 : :
340  GOSUB 260
342  FOR J = 1 TO N
343  IF N%(J) = WH THEN  GOSUB 350
345  NEXT J
347  GOTO 331
348 : :
350  REM
352  GOSUB 100
354  GOSUB 115
356  GOSUB 135
358  GOSUB 140
359  GOSUB 150
360  GOSUB 165
361  GOSUB 170
362  GOSUB 16
363  RETURN
```

```
364 : :
365  REM  SEQUENTIAL INPUT
366  HOME
367  GOSUB 12
368  PRINT  TAB( 10)"'SEQUENTIAL INPUT'"
369  GOSUB 14
370  GOSUB 260
372  FOR J = 1 TO N
374  GOSUB 100
376  GOSUB 115
378  GOSUB 135
380  GOSUB 140
382  GOSUB 150
384  GOSUB 165
386  GOSUB 170
387  PRINT "'RETURN' TO END";: GET A$: IF A$ =  CHR$ (13) THEN 394
388  PRINT : NEXT J
390  GOSUB 16
392  GOSUB 600
394  RETURN
399 : :
500  REM  MAIN PROGRAM
502  CLEAR : HOME
503  VTAB (8): GOSUB 11: PRINT : GOSUB 296: GOSUB 12
505  DIM OT(100),PT(100),TT(100),AO(40),DO(40),PO(40),DE(40),AP(40),DP(40)
     ,PP(40),DD(40)
506  DIM DV(100),EE(100),J(200)
507  DIM JE(20)
508  DIM AN(20),K(20)
509  DIM SF$(40),PH$(40),N$(40),N%(40)
510 TT = 0:OT = 0:PT = 0
511  PRINT
512 : :
515  INPUT "MONTH,YEAR:";M,Y
516  PRINT "AMOUNT NOW IN BUDGET=$";PB
517  INPUT "PROJECT BUDGET LIMIT:$";PB
519  PRINT
520  GOSUB 300
522  GOSUB 527
524  GET AN$: IF AN$ = "0" THEN  END
526 : :
527  HOME : VTAB (5): GOSUB 14
528  PRINT "WHAT NOW?"
530  PRINT "0-END": PRINT "1-MORE INPUT": PRINT "2-REPORTS": PRINT "3-STAR
     T OVER"
535  INPUT "#:";NR
536  IF NR = 0 THEN  GOSUB 290
537  IF NR =  > 4 THEN 527
538  IF NR = 3 THEN 516
539  IF NR = 1 THEN  GOSUB 330
540  IF NR = 2 THEN  GOSUB 600
545  RETURN
550 : :
600  REM PRINT OUT
601  HOME : GOSUB 60
602  INPUT "WANT INDIVIDUAL REPORTS?(1)";RI
603  IF RI <  > 1 THEN 606
604  HOME : GOSUB 11: GOSUB 82
605 : :
606  PRINT : PRINT "NOW FOR REPORTS!": GOSUB 16: HOME
607  GOSUB 12: GOSUB 296
608  GOSUB 12
610  PRINT  TAB( 7)"PAGE 1:SUMMARY REPORTS": PRINT
612  PRINT  TAB( 5)"STARTING DATE:"M","Y
614  PRINT  TAB( 5)"BUDGET:$";PB
616  PRINT  TAB( 5)"TOTAL EXPENSES=$";TT
617  PRINT  TAB( 5)"BUDGET/EXPENSE DIFFERENCE=$";PB - TT
618  PRINT  TAB( 5)"PROJECT TIME =";D1;" DAYS"
619  PRINT  TAB( 5)"MONTHS=";M1: PRINT  TAB( 5)"YEARS=";Y1
620  PRINT  TAB( 5)"TOTAL OFFICE:$";OT
622  PRINT  TAB( 5)"TOTAL WORK:$";PT
624  PRINT  TAB( 5)"TOTAL # OF INPUTS:";IN
626  GOSUB 12
628  GOSUB 16
629 : :
630  HOME
631  GOSUB 12
632  PRINT  TAB( 8)"'OFFICE EXPENSE REPORT'": PRINT  TAB( 8)"............
     .........."
634  PRINT
636  GOSUB 94
637  PRINT AO
638  GOSUB 95
639  PRINT DO
640  GOSUB 96
641  PRINT PO
642  GOSUB 97
643  PRINT DE: PRINT
644  PRINT  TAB( 7)"YEARLY SUPPLEMENT:$";OT / 10
646  PRINT
647  GOSUB 12
648  PRINT  TAB( 6)"'FUNCTION EXPENSE REPORT'"
650  PRINT  TAB( 6)"........................."
652  GOSUB 94
653  PRINT AP
654  GOSUB 95
655  PRINT DP
```



Reader Service—see page 257

```
656  GOSUB 96
657  PRINT PP
658  GOSUB 97
659  PRINT DD
660  PRINT
662  PRINT  TAB( 7)"ONGOING COSTS:$";PT / 10
664  GOSUB 12
665  ::
668  GOSUB 16
670  HOME
672  GOSUB 12
674  PRINT  TAB( 11)"'COMBINED REPORTS'": PRINT  TAB( 11)"...............
     .."
676  PRINT : PRINT
678  GOSUB 94
679  PRINT AO + AP
680  GOSUB 95
681  PRINT DO + DP
682  PRINT
684  GOSUB 96
685  PRINT PO + PP
687  GOSUB 97
688  PRINT DE + DD
690  PRINT
692  PRINT  TAB( 7)"TOTAL ONGOING COSTS=$";TT / 10
694  ::
695  GOSUB 12
696  GOSUB 76
698  GOSUB 16
699  RETURN
```

*Robert B. Silvey*
*American National Insurance Co.*
*One Moody Plaza*
*Galveston, TX 77550*

# Advice to the Beginning Programmer

*Taking on your new Whizbang 80 step by step.*

```
 10 REM CONTROL SECTION
 20 REM CONTROLS PROCESSING REQUESTS
 30 REM
 40 PRINT 'ENTER FUNCTION TO BE PERFORMED:'
 50 PRINT 'A=ADD, P=PRINT LEDGER'
 60 PRINT 'C=CLOSE LEDGER, E=END'
 70 INPUT T$
210 IF T$='A' GOSUB 300:IF T$='P' GOSUB 500
220 IF T$='C' GOSUB 700:IF T$='E' GOTO 800
230 GOTO 40
300 REM INPUT SECTION
310 RETURN :REM "DUMMY SECTION"
500 REM LEDGER PRINT SECTION
510 RETURN :REM "DUMMY SECTION"
700 REM CLOSE LEDGER
710 RETURN :REM "DUMMY SECTION"
800 REM EXIT ROUTINE
810 STOP
```

*Listing 1.*

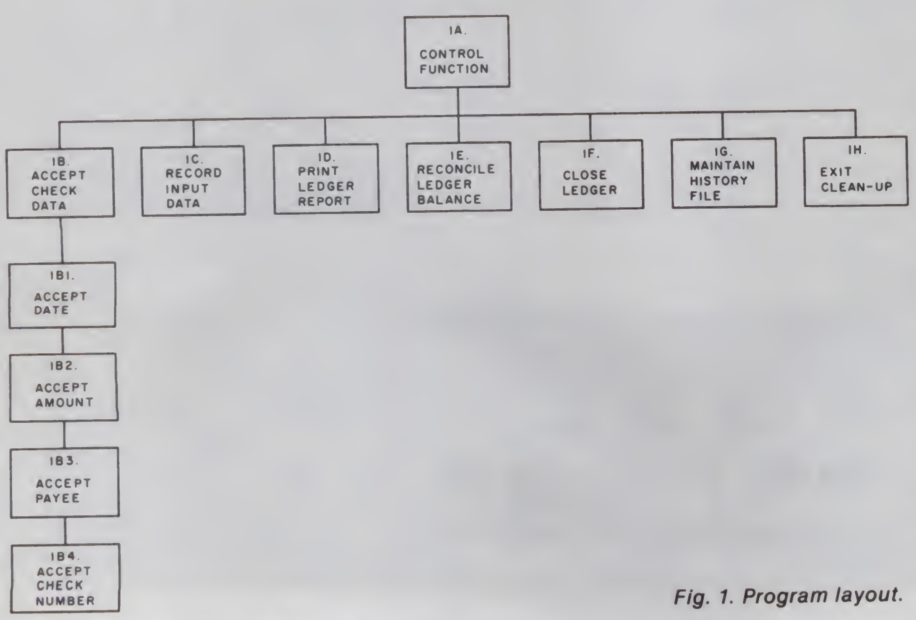



*Fig. 1. Program layout.*

Your new Whizbang 80 has just arrived, and you've torn open the carton, eager to enter into the fascinating world of the computer.

If you're like most newcomers, the first thing you'll want to do is write *programs*. You rapidly read through the instruction manual and learn enough BASIC to begin to converse with your new machine. The natural inclination at this point is to start writing all of those super programs you've been dreaming about.

Unfortunately, this may be the worst thing you can do. If you continue to pursue such a course, you'll probably end up feeling limited in your achievements. Worse yet, you may become disenchanted with computers and leave the hobby altogether.

### Programming Prerequisites

There is more to writing effective programs than generating program code. In fact, generating code is way down the priority list for novices.

So what is important? A sound and trained thought process. You need to think conceptually about what you are trying to accomplish. A computer cannot read your mind or interpret what you really mean to say. You must be specific when telling the computer what to do, though you need not understand the inner workings of the computer. You don't even have to understand binary, octal, hexadecimal and other seemingly foreign concepts to effectively use your new computer.

Designing a program is similar to preparing for a trip. First you need a destination. Then you need a route. Finally, you need a map. By reducing a large and complicated

process into a series of small, easily-achieved steps, you reduce the frustrations that come from trying to solve the whole problem at one time.

Every program should begin with a well-formed statement of exactly what the program is supposed to do. You would be surprised at how many programs are started before the author knows his own intentions. Make it a practice to always have a statement of purpose before you begin.

Next, begin to write down an explanation of exactly how the program will achieve the intended purpose. You must understand the process and be able to describe it in plain English before you can ever hope to program the computer to do it.

**Structuring Your Program**

Much has been written about structured design and top down approaches. Unfortunately, these techniques often become too involved in their own internal structures and symbolism. You don't need a rigidly structured system for describing your process. I suggest an outline approach.

Begin with the global statement of purpose. For example:

I. A system to handle the entire processing of a personal checkbook and ledger.

Add more definitive breakdowns of the procedures:

IA. Control function.
IB. Accept check input data.
IC. Keep record of input data.
ID. Print ledger report on request.
IE. Reconcile ledger and produce balance.
IF. Close ledger at end of month.
IG. Maintain a transaction history file.
IH. Exit and clean-up routine.

Break down each step into smaller and more definitive steps:

IB1. Accept date.
IB2. Accept amount.
IB3. Accept payee.
IB4. Accept check number.

Break down until you feel you can go no further. Keep in mind that the substeps at each level must cover everything stated in its preceding level. For example, steps IB1 through IB4 must state everything IB is to accomplish.

You may find it helpful to graphically lay out how the major parts of the program will fit together. This provides you with quick visual overview that you can scan for any obvious missing pieces. (See Fig. 1 for example.)

Again, don't get hung up on fancy symbols. Simple rectangles will suffice.

Once this is completed, group those substeps that logically belong together and make them segments of your program.

Using the preceding example, your program might be structured as follows:

10.200—Control section to handle process requests.
210.250—Gosubs to various substeps.
300.350—Input section.
400.450—File update section.
500.550—Ledger print section.
600.650—Reconciliation and balance section.
700.750—Close and update section.
800.850—Clean-up and exit routine.

By structuring your program this way, you can test it in a modular fashion. Once you have the control section coded, you can put in dummy return sections for each of the subroutine sections and test the control section. A dummy return section is merely a basic return placed at the line location at which a GOSUB expects to find another processing section in the program.

By including these you can test the control section without having to complete the code for all of the other sections in the program. (See Listing 1.)

Once you have the control section working, complete the subroutine sections one at a time. Replace the dummy sections with the new code and test it. Continue this process until each section of the program is completed and tested.

By following the process described here, you will be able to complete a large and complex process in a series of smaller, easier-to-handle parts. The end program will also be easier to modify or add to.

So before you pick up that pencil and start writing programs, make sure that you know where you are going and how you are going to get there. You and your new Whizbang 80 will have a happier and hopefully longer relationship. ■

✓Reader Service—see page 257


SAVE ON
TRS-80's
from
Pan American
Electronics, Inc.
71
A Radio Shack
AUTHORIZED SALES CENTER
Model I
We Have
DISCOUNTS
FREE SHIPPING
and a
TOLL FREE ORDER NUMBER
800/531-7466
Texas and Principle Number 512/581-2765
Telex Number 767339
Department K
1117 Conway
Mission, Texas 78572
MasterCard
VISA®
Model III
Color Computer
Pocket Computer

# KILOBAUD KLASSROOM NO. 23

# Assembly-Language Programming

*Learn the tenets of assembly-language programming, which, mnemonically speaking, can be more flexible than machine language or high-level languages.*

*Peter A. Stark*
*PO Box 209*
*Mt. Kisco, NY 10549*

Last month we discussed what machine language is, how it is stored in a typical microcomputer, what is meant by the instruction set of a computer and how it relates to assembly language.

This month we want to narrow down on assembly language itself. If you have access to a computer that can run BASIC programs, it will be useful if you have already entered the 6802 cross-assembler presented last time, because we'll use it as a learning tool. (If, however, you do not have access to a computer which can run it, don't despair. I'll try to make the article complete enough so that you will still get the idea.)

### Machine-Language Review

A simple demonstration program last month ran as follows:

| | | | |
|---|---|---|---|
| 1000 | 4F | | Clear accumulator A |
| 1001 | 8B | 05 | Add 5 to A |
| 1003 | 8B | 02 | Add a 2 to get 7 |
| 1005 | B7 | 2000 | Store result in location 2000 |
| 1008 | 7E | 1008 | GOTO 1008 |

Each line of this program is a separate instruction. The left column is the address where the instruction is stored. The second contains all the operation codes which specify the operation to be performed. The third contains the operands which give additional information for some instructions. Finally, at the right are some comments. These appear on well-written programs, but are not used (or even read) by the computer.

As mentioned last time, various instructions have different lengths. In the 6802, which we are specifically dealing with because it is used in the Kilobaud Klassroom Komputer, all the operation codes are exactly one byte, or two hex digits, long. In some other computers they may be two bytes long.

However, in almost all microprocessors the operands are of different lengths, depending on the type of instruction. In the above sample, we see that the first instruction has no operand and is therefore only one byte long. The next two instructions have a one-byte operand and therefore are two bytes long. Finally, the last two instructions have two-byte operands and are therefore a total of three bytes long.

### Assembly Language

In assembly language, a program is divided into the same four columns as our machine-language program above. We have columns for addresses (except that here they are called labels), operation codes, operands and comments.

The same program in assembly language might look like this:

| Label | Operation Code | Operand | Comments |
|---|---|---|---|
| START | CLRA | | Clear accumulator A |
| | ADDA | #5 | Add 5 to A |
| | ADDA | #2 | Add 2 to A |
| | STAA | $2000 | Store result in location 2000. |
| HERE | JMP | HERE | Stop in a loop |

These are the same basic four columns. Actually, though, in the case of the 6802 the operation code column is often split into two columns to separate the letter that identifies the accumulator from the op code itself for clarity. As a result, the program may look as follows:

| Label | Operation Code | Operand | Comments |
|---|---|---|---|
| START | CLR A | | Clear accumulator A |
| | ADD A | #5 | Add 5 to A |
| | ADD A | #2 | Add 2 to A |
| | STA A | $2000 | Store result in location 2000. |
| HERE | JMP | HERE | Stop in a loop |

Let's look at these columns one by one.

### The Label Column

Assembly language differs from both machine language and even some higher-level languages like BASIC or FORTRAN by using labels to refer to instructions as well as data. The label column at the left is used to identify those lines that will somehow be referred to by other parts of the program. Thus, the middle three lines of the sample program have no labels for the simple reason that they do not need them.

It is allowable to assign labels even to lines where they are not needed. Hence the label START, even though never referred to in the rest of the program, is there so that the programmer, or anyone else, can quickly spot the beginning of the program.

In most systems there are some fairly logical restrictions on labels. Generally, they must start with a letter, contain only letters and numbers and have a maximum length of six or so characters.

### Operation Code Column

Like the op code in machine language, the operation column in assembly language specifies the operation to be done. But instead of using the numerical op code, assembly language uses the same mnemonics that were listed in the instruction set tables shown last time. Thus, CLR A is used instead of 4F; ADD A is used instead of 8B, and so on.

In some cases, each mnemonic corresponds with exactly one op code; translation from one to the other is then simple. In others, there may be several different op codes for each mnemonic; then the choice of op code may involve some additional data as well. For instance, in the 6802 some instructions have several addressing modes. In that case, there are several machine-language op codes for each mnemonic, and the assembler makes its choice based on the exact structure of the operand.

The assembler, of course, is the program that does the actual translation from assembly language to machine language. In this translation, the assembly-language program being translated is called the source program, while the resulting machine-language program is called the object program.

To do the translation correct-

ly, some additional information must be given to the assembler. This is done by means of pseudo-instructions or assembler directives, two names for the same thing.

Assembler directives or pseudo-instructions are slipped into the source program in the same way as real instructions, except that they use operation codes that have some specific meaning to the assembler, but do not actually get translated into machine-level instructions. For example, ADD is a real instruction code which is translated into a machine-language op code. On the other hand, END is a pseudo-op code that would also appear in the operation code columns, but would not be translated into any specific instruction. (In assembly language, the END assembler directive simply tells the assembler that it has reached the end of the program and can stop translating.)

### Operand Column

The operand column contains information that will (except in the case of assembler directives) be translated into machine-language operands.

As you can see from the above example, the operand can be either numeric or a label; in some cases, it can also be a combination of several such elements.

In most cases it is important to examine the operand column carefully, since not reading the fine print can lead to a mistake. With the 6802, the operand can be one of six types:

1. An alphanumeric label.
2. A plain number, which is assumed to be in decimal.
3. A number preceded by $, which is always hexadecimal.
4. An alphanumeric character preceded by ', which represents the ASCII code for that character.

In addition, any of the above preceded by # implies immediate mode, and any of the above followed by ,X implies indexed mode.

Thus, the instruction ADD A #2 means that the 2 is an immediate operand.

A few examples should help clarify that.

ADD A $0055 tells the computer to add the contents of memory location 0055 to accumulator A. ADD A $55 means the same thing.

ADD A 55 instructs the computer to add the contents of memory location 0037 to accumulator A. Here, the 55 is assumed to be a decimal number, which translates to a hex 37.

ADD A #$55 means "add the number $55 to accumulator A." This adds the equivalent of a decimal 85, because # implies the immediate mode.

ADD A #55 adds the decimal number 55, or a hexadecimal 37. Note that if we pronounce the # symbol as "the number," it makes more sense than if we keep referring to immediate mode.

ADD A $55,X is an indexed instruction with the operand a hexadecimal 55.

### Comment Column

Not much need be said about the comments column except that it is used to add comments to a line. In that sense, it is similar to adding :REM to those BASICs that allow multistatement lines.

Most assembly languages allow remarks or comments to be placed on separate lines as well, just like the REM statement in BASIC. In 6802 assembly language, all lines which begin with * are assumed to be remarks and are ignored by the assembler.

### Source Code Format

Now that we know something about the structure of an assembly-language program, we need to know how to feed that program to an assembler.

Up until recently, most large computer installations required that programs be submitted on punched cards. The cards were prepared on a machine called a keypunch, and specially formatted blank cards were used to hold assembly-language programs. To make the job of the assembler easier, each component of an assembly-language statement needed to be in a specific place on the card. For instance, columns 20–26 of the card might be reserved for la-

bels; columns 28–30 might be reserved for operation codes, and so on.

While this sort of arrangement is convenient for punched cards since it makes a card deck easy to read and process, in any computer where the assembly-language source program is stored in tape (either paper or magnetic) or disk, this format wastes space by requiring the storage of blank columns which do not hold any useful information.

With the advent of computers that are programmed from a terminal, this kind of format also wastes time while the typist enters extra spaces or tabs to move to the required columns. Hence, most assemblers that operate on timeshare systems, or on mini or microcomputers, allow a slightly different format.

In general, labels always start at the beginning of a line (essentially what corresponds to column 1). If a label is used, then the operation code is separated from the label by a space; if not, then the operation code begins in column 2. Everything else then follows, separated from the previous column by a space. This compresses the program and makes it take up less room, but it also makes the program harder to read and decode. For instance, our sample program now looks like this:

```
START CLR A Clear accumulator A
 ADD A #5 Add 5 to A
 ADD A #2 Add 2 to A
 STA A $2000 Store result in location 2000.
HERE JMP HERE Stop in a loop
```

Although the actual source program may look like this when it is entered into the computer, the assembler separates out the various columns without too much trouble. Moreover, if a printout is requested from the assembler, then the printed listing will be properly formatted into columns as in the original examples.

### The 6802 Cross-Assembler

We will shortly use the 6802 cross-assembler from the last installment to assemble a few short 6802 programs. But we should first look at a few of its features and limitations.

In order to keep the cross-assembler simple and to speed up processing of the source program, I have added one constraint to the source code format: The various columns in the source code must be separated by commas. This makes it easy for BASIC to read each entry into a different string variable and process it.

Thus, the above program would have to be entered like this:

```
START,CLR A,,Clear accumulator A
,ADD A,#5, Add 5 to A
,ADD A,#2, Add 2 to A
,STA A,$2000,Store result in location 2000.
HERE,JMP,HERE,Stop in a loop
```

Note how each line has exactly three commas separating the four columns. If an entry is missing, then the comma is preceded by a blank. Thus, the double comma in the first line means there is no operand; the next two lines begin with commas because there is no label.

The 6802 cross-assembler program has been tested on several BASICs, including the Microsoft Level II BASIC on a TRS-80. Some BASICs, however, do not like or consider null strings to be the same as a string containing one space, whereas it should be empty. If in doubt, try the following one-line program:

```
10 IF " " <> "" THEN PRINT "OK"
```

Note the space between the first quotes, but not the second. If this program prints the word OK, then the cross-assembler should run OK. If not, then it may be necessary to replace every occurrence of the null string "" in the program by "-", and enter a - instead of the null string during input.

For instructional purposes, this cross-assembler takes all input from the keyboard (using the input statement in line 270) and outputs back to the screen or terminal (using all the statements which read PRINT #P4, . . .). Thus we can immediately see it work, line by line.

All machine-language code is printed by line 2880. If you want to use the assembler on a disk or tape system, it may later be convenient to change line 270 so it reads the source code from a disk or tape file, and add another PRINT just after line 2880 to write the object code back to a disk or tape file.

This program was written on a



✓ Reader Service—see page 257

BASIC system which allows output to be steered to an alternate port by specifying a different port number in the print statement. Hence all print #P4 statements print on port 1 in this system (since P4 is set to 1 at line 210). If your system does not allow this option, you may want to delete all references to P4 and substitute an allowable form. For example, on a TRS-80 these print statements could be changed to LPRINT to steer output to a printer.

The BASIC on which the following samples were run also fills in missing strings with nulls. That is, if an input statement reads

```
100 INPUT A$, B$
```

then inputting just a single string for A$ makes B$ null.

If you have any problems implementing the assembler on your BASIC system, send me a self-addressed stamped envelope for a sheet of additional hints.

### Assembling a Simple Program

Let us now use the 6802 cross-assembler to enter and assemble a simple assembly-language program. We enter the program and type RUN. After an initialization, the assembler returns with the prompt ?, and we are ready to start typing in the first statement.

Although in more sophisticated systems it is possible to write programs in a so-called relocatable format (where we do not have to specify to the computer where in memory the program is to be put), in most microcomputer systems we must specify a starting location for the program. The common way of specifying this is via an ORG assembler directive like this:

```
,ORG,$1000,Origin
```

As soon as we end the line with a return, the assembler returns with

```
(1000)              ORG   $1000  Origin
```

It has parsed the line (separated the parts) and printed it in a more readable format.

The ORG assembler directive tells the assembler that all following code is to be placed in memory starting at location 1000. (The $ signifies that a hexadecimal address is being used.) This assembler places the number 1000 in parentheses to signal that this is assembler internal data, and not really part of the machine-language program.

```
? START,CLR A,,Clear accumulator A
1000 4F           START  CLR A            Clear accumulator A
? ,ADD A,#5,Add 5 to A
1001 8B  05              ADD A    #5      Add 5 to A
? ,ADD A,#2,Add 2 to A
1003 8B  02              ADD A    #2      Add 2 to A
? ,STA A,$2000,Store in 2000.
1005 B7  2000            STA A    $2000   Store in 2000
? HERE,JMP,HERE,Stop in a loop
1008 7E  1008 HERE       JMP      HERE    Stop in a loop
? ,END
                         END
```

*Listing 1.*

Let us now enter the preceding program to add two numbers. Each new statement is entered after BASIC prompts us with a ? (see Listing 1).

The resulting display is a bit hard to read because it consists of two parts, interleaved line by line. These are the lines we entered.

```
? ,ORG,$1000,Origin
? START,CLR A,,Clear accumulator A
? ,ADD A,#5,Add 5 to A
? ,ADD A,#2,Add 2 to A
? ,STA A,$2000,Store In 2000.
? HERE,JMP,HERE,Stop in a loop
? ,END
```

The lines which the assembler has printed are shown in Sample run 1.

```
     (1000)               ORG    $1000  Origin
1000 4F            START  CLR A         Clear accumulator A
1001 8B  05               ADD A  #5     Add 5 to A
1003 8B  02               ADD A  #2     Add 2 to A
1005 B7  2000             STA A  $2000  Store in 2000
1008 7E  1008  HERE       JMP    HERE   Stop in a loop
                          END
```

*Sample run 1.*

We see here that the assembler has greatly simplified the writing of this program for us. Once we specify where the program is to start, by means of the ORG statement, we no longer have to worry about memory assignment. The assembler keeps track of instruction lengths and assigns the correct number of bytes to each instruction.

It also takes care of converting the mnemonic codes for each operation code to the hexadecimal equivalent. And finally, by assigning labels we are even freed of the drudgery of keeping track of what is where. The assembler keeps its own internal tables which tell it that location HERE is the same as 1008.

The latter is very important. As you may well know by now, few programs ever run correctly the first time. It is often necessary to add or delete a few statements in the middle of a program. If the program were written in machine language, then each time we added or removed a statement we would have to completely reassign all the addresses from then on.

But in assembly language, adding or removing a line makes no more work for us. For example, if we added an extra line into the program, the assembler would simply move HERE from 1008 to 1009 or where needed.

### Assembler Directives

We have so far seen two assembler directives (pseudo-ops)—ORG and END. Any good assembler, though, has a good many more than that.

Some of the directives provide only information to the assembler and have absolutely no effect on the resulting object program. For instance, our assembler permits the following:

END tells the assembler to stop assembling. (Unlike an END in BASIC, here the END means nothing to the final program. It is strictly a notice to the assembler to stop translating.)

NOL tells the assembler to accept source code as input, but not to print the resulting object code (unless there is an error). This is often used to avoid long printouts of programs with many errors; specifying a NOList makes it print only lines which have errors.

LIS reverses the effect of NOL and lists the program.

Other directives have a roundabout effect on the program in that they affect what happens later:

ORG specifies the origin or first address used by the program. If desired, following portions of the programs can be placed at different locations by issuing a new ORG directive.

EQU is used to equate a label to a number or address for later use without doing anything right now. For example, the statement

```
NAME EQU $0100
```

makes the assembler substitute the hexadecimal value 0100 every time the word NAME appears in the program.

The third type of assembler directive is used to define data or variable areas for the program, in the same way DIM or DATA statements *function in* BASIC.

RMB stands for reserve memory bytes, and is the closest to BASIC's DIM statement. Using RMB, we can reserve one or more memory locations for later use as data or variable storage. A typical RMB statement might be

```
NAME RMB 10
```

which would instruct the assembler to set aside the next ten locations in memory for future use and assign the first location the name NAME.

In some ways this is similar to BASIC's DIM NAME(10), except that in assembly language only the first location reserved is assigned the name, while the others have no name. They can, nevertheless, be accessed

# KING OF THE HILL!

We've taken artistic license with our illustration in order to make a point: MYCHESS is the most powerful microcomputer chess program on the market, bar none.

Proof? All you want and then some. For example, MYCHESS was the winner of the "Fifth West Coast Computer Fair". At the "Third World Computer Chess Championship" in Linz, Austria, it was the highest finishing micro... in addition to winning the special Blitz Tournament (5 to 1) against six top players. Add to this its USCF rating of 1565, and you know you're dealing with the King of the Hill.

You'll find MYCHESS is the perfect companion or opponent whether you're an advanced player, or starting your first game. For it lets you set the difficulty of the game from level 1 to 9. And, you can change levels of play as you go ... or even change sides. Want to set time limits for moves? MYCHESS can do it. Want to save a game for later? MYCHESS will store up to 6 games. And, for added interest, it will even predict the upcoming line of play.

If you're a player, you'll appreciate the MYCHESS challenge. If you're a beginner, you'll enjoy learning from a master. Either way, when it comes to superior chess, make your move ... to MYCHESS. Available for the TRS-80* with 32K, for $34.95 including disk, documentation and backing by Programma International. Apple** version coming soon.

Can **you** beat

# MYCHESS


PROGRAMMA

**3400 Wilshire Blvd.**
**Los Angeles, Ca 90010 (213) 384-0579**

*TRS-80, a Tandy Corp. trademark. • Microchess, a Personal Software, Inc. trademark. Sargon, a Hayden Book Co., Inc. trademark. • **Apple, an Apple Computer, Inc. trademark.

```
  (1000)                     ORG              $1000
1000  B6  ....    START      LDAA   NUM1      Load first number
1003  BB  ....               ADDA   NUM2      Add the second number
1006  B7  ....               STAA   ANSWER    Store the result
1009  7E  1009    HERE       JMP    HERE      Loop to stop
1000  B6  100C
100C      05      NUM1       FCB    5         First number
1003  BB  100D
100D      02      NUM2       FCB    2         Second number
  (2000)                     ORG    $2000
1006  B7  2000
  (2000)          ANSWER     RMB    1         Space for answer
                             END
```

*Listing 2. One-pass assembler.*

either through indexed addressing or by specifying their address.

FCB means form constant byte and sets aside one location for one byte. RMB 1 does that too, but FCB has the further function of initializing that byte to some value. For example,

```
NUMBER FCB 5
```

sets aside one location, gives it the name NUMBER and puts the byte 05 into it.

```
NUMBER FCB $4E
```

would initialize that location to a hexadecimal 4E.

```
NUMBER FCB 'A
```

would put into that location the ASCII code for an A, which is hexadecimal 41.

FDB, form double byte, is similar to FCB, except that it sets aside two adjacent locations. FDB statements are often used to define locations which hold addresses. For example, the statement

```
LOC FDB $1234
```

would set aside two locations, give the first the name LOC and put the hexadecimal number 1234 into them. (A 12 would go into the lower-number location, and 34 into the higher-numbered one.)

FCC, form constant character, is used to reserve an entire block of locations and initialize them with a string. For example,

```
QUEST FCC "WHAT NOW, SIRE?"
```

sets aside 16 locations (for that is the length of the string), gives the first location the label QUEST and initializes the 16 locations to contain the string WHAT NOW, SIRE? The quotes before and after the string are called delimiters and are not considered part of the string. (The delimiter need not be quotes; any character not appearing in the string itself can be used.)

We thus have four assembler directives which are used to insert data, or space for variables, into a program. We must, however, be careful not to position the data so that the program tries to execute it as instructions. The data should be either before the program, after it, or in the program but preceded by GOTO (JMP or BRA in assembly language) statements, which sidetrack the program and send it elsewhere before it can accidentally step into data.

### Assembly Passes

Let's try another variation of the program to add two numbers. This time we will use assembly language with separate data areas for the numbers as well as the answer. Using your cross-assembler, enter the following program:

```
,ORG,$1000
START,LDA A,NUM1,Load first number
,ADD A,NUM2,Add the second number
,STA A,ANSWER,Store the result
HERE,JMP,HERE,Loop to stop
NUM1,FCB,5,First number
NUM2,FCB,2,Second number
,ORG,$2000
ANSWER,RMB,1,Space for answer
,END
```

Listing 2 shows the assembly printout from our cross-assembler, while Listing 3 shows the printout for the same program, but assembled by a different assembler. Aside from the slightly different formatting and spacing, there is one major difference between the two. In Listing 3 the first instruction is printed as

```
1000 B6 100C
```

whereas in Listing 2 it appears as

```
1000 B6 ....
```

The first is obviously correct, so why do the periods appear in

```
     (1000)              ORG    $1000
1000  B6  100C  START    LDA A  NUM1     Load first number
1003  BB  100D           ADD A  NUM2     Add the second number
1006  B7  2000           STA A  ANSWER   Store the result
1009  7E  1009  HERE     JMP    HERE     Loop to stop
100C  05        NUM1     FCB    5        First number
100D  02        NUM2     FCB    2        Second number
     (2000)              ORG    $2000
2000            ANSWER   RMB    1        Space for answer
                         END


     SYMBOL TABLE:
ANSWER    2000    HERE    1009    NUM1    100C    NUM1    100D
START     1000
```

*Listing 3. Two-pass assembler.*

Listing 2?

The answer is that our 6802 cross-assembler is a one-pass assembler. It receives the source code from the keyboard just once, and immediately outputs the object code. When it processes the first line

START LDA A NUM1

it does not yet know when and where NUM1 will in fact be. That is, this statement uses a label in the operand which has not yet been defined. Hence it does not yet know what address to use for it. The best it can do is leave the address blank. So it substitutes four periods to let us know that something is missing.

Note, though, that just four lines below is the correct output

1000 B6 100C.

Although the assembler doesn't know what to do with the undefined label, it remembers it, and later, when NUM1 is finally defined, it puts in the correct instruction. In Listing 2 this happens three times—once for each of the first three lines. (Had NUM1 been defined before it was used, this would not have happened.)

But why did the assembler used for Listing 3 not have this problem? Simple. Listing 3 was assembled on a disk-based assembler, which kept the source code on disk rather than accepting it from a keyboard. Although it is not apparent to the user, this assembler reads the source code from the disk twice—once to search through for all the labels and make a label table, which lists each label with its correct address, and the second time to do the final assembly and print out the object code. Such an assembler is called a two-pass assembler, since it makes two passes through the source code. Most assemblers are two-pass; our 6802 assembler is not, because it would get rather tiring to have to type in the source code twice.

A two-pass assembler need not necessarily use a disk. If the source program is stored on disk or cassette, it can obviously be read twice. If the source program is small enough, and computer memory is large enough, then the source code can be stored in memory and read twice from there.

By the way, Listing 3 also shows an optional printout available from some assemblers. At the bottom we see a symbol table, which lists all the labels in alphabetic order and their addresses. This is often very useful for later debugging a program. To keep the program short, our 6802 cross-assembler does not offer this feature, although it could easily be added.

### The Stack

Machine and assembly language have instructions similar to BASIC's GOSUB and RETURN. The GOSUB is called JSR (jump to subroutine) or BSR (branch to subroutine), whereas the return is now called RTS (return from subroutine). (The difference between JSR and BSR is that they use slightly different addressing modes, and BSR can only go to subroutines that are in nearby memory locations, whereas JSR can go to subroutines located anywhere in memory.)

As in BASIC, each time the program goes to a subroutine, the computer must keep track of



✓Reader Service—see page 257

where it came from so it can return back to that place.

If a main program calls subroutine A, and this subroutine in turn goes to subroutine B, then the returns must be done in reverse order—the computer must return from B to A, and then from A to the main program. Since it is possible that a program might go through several subroutine calls before it starts to return, all of the returns must be properly handled in reverse order.

In both BASIC as well as machine language, each time the program goes into a subroutine, the line number or address of the next instruction after the GOSUB is stored in an area called the stack. As the subroutine returns, this line number or address is then read back from the stack. Since the return address put into the stack last must be read first, the stack is said to be a LIFO, or last-in-first-out, stack.

In some older microprocessors the stack was a group of registers directly inside the processor. This turned out to be an inefficient design for two reasons. First, it used up valuable space in the processor that could be used for more important circuitry. Second, no matter how many locations were set aside for the stack, a program that needed more always came along at some point.

Thus, the newer processors put the stack into memory. This leaves the programmer the option of setting aside as much memory for the stack as he wants. The processor then contains a single register called the stack pointer, which always points to the next empty location of the stack.

It is common to use the high end of RAM in a 6802 system for the stack. If, for example, the computer has RAM from location 2000 to 2FFF, then the area just under 2FFF would be used for the stack. Since the stack fills from the top down, the stack pointer would normally be set to point to 2FFF when the computer is first started with an LDS #2FFF instruction. This is an immediate mode instruction which loads the stack pointer with the hexadecimal ($) number (#) 2FFF.

Each time a jump or branch to a subroutine instruction is performed, the processor automatically puts the address of the next instruction after the jump or branch on the stack. Since each memory location is just eight bits, whereas the return address takes 16 bits, the address takes up two memory locations. As soon as it is placed into the stack, the stack pointer register is automatically decremented by two so that it again points to an empty location just below the two that were just filled.

On a return statement, the opposite happens—the two-byte return address is taken back off the stack, and the stack pointer is incremented by two.

The stack is needed for subroutine calls, but in many processors it is also usable for other things. It is also used when interrupts occur—when an interrupt arrives and is recognized by the computer, all the processor registers get placed in the stack. In the case of the 6802, this involves seven bytes, and so the stack pointer is decremented by seven. This saves the complete status of the processor, so that it can go off and execute an interrupt service subroutine, yet return to the main program and reset all registers so it can pick up wherever it had finished.

Another common use of the stack is for temporary storage of data. For example, the 6802 has a pair of PSH (push) and PUL (pull) instructions which are used to temporarily save the contents of either accumulator on the stack. (In other computers they may be called PUSH and POP.) The push and pull instructions are more efficient than using some other memory location for storage, since they use only one byte of program code instead of the two or three which might otherwise be required.

### Condition Codes

Every computer needs the ability to make decisions based on some event. In BASIC this is handled by the IF statement; in machine and assembly language it is generally handled by a series of conditional jump or branch instructions.

BASIC's IF has several forms. The simplest is the form IF... GOTO..., which causes a conditional GOTO to some other statement if a certain condition is satisfied. This form is generally implemented in machine and assembly language; the more complex

IF . . . THEN do something

is not present in these lower-level languages.

The difference is that BASIC's IF combines two things into one statement, whereas in machine and assembly language they are split. BASIC first does the comparison called for between the words IF and GOTO and makes a note whether the test being made was true or false. Then, as the second part, it does the GOTO if the test result was true. BASIC's IF does both of these in one statement.

In machine or assembly language, the comparison or test must be performed separately from the GOTO. For example, the BASIC statement

```
IF X - Y = 0 GOTO 100
```

could be coded in assembly language as

```
LDA  A X       Load value of X
SUB  A Y       Subtract value of Y
BEQ    $0100   If result is zero go to 0100
```

This makes sense when we realize that machine or assembly-language instructions are of necessity shorter than BASIC statements, and therefore cannot present as much information to the computer on one line.

The question then comes up—how does the processor remember whether the result of the calculation in the second line was zero or not? Better yet, how long will it remember? If we stuck in one more line between the SUB and the BEQ, would the computer still remember what happened in the SUB?

Every processor maintains a group of flip-flops or other storage elements which remember certain events from one instruction to the next. In the 6802 there are six of these, and together they are grouped into the condition code register. This six-bit register can be manipulated by several specific instructions, but this is seldom done. Most often, the contents of this register are used to decide whether conditional branches are done or not.

The six bits are called the HINZVC bits. Each of the letters stands for something:

H—Half-carry bit. In certain operations, a carry from the right half of a byte into the left half sets this bit, which is used mostly in decimal arithmetic, where each half of a byte represents one decimal digit.

I—Interrupt mask bit. If this bit is a 1, IRQ interrupts are masked—prevented from interrupting the program.

N—Negative bit. When the result of an operation is negative, this bit is a 1.

Z—Zero bit. When the result of an operation is zero, this bit is a 1.

V—Overflow bit. Whenever an operation results in a carry from the seventh bit in a byte into the leftmost byte, this bit is a 1. This bit is used most often in two's complement calculations.

C—Carry bit. This bit holds the carry bit in operations where an answer requires more than the eight bits of a byte. That occurs when the sum of two num-

```
      (0100)                 ORG      $0100
0100  4F          START      CLR  A            Start with Acc. A zero
0101  C6  0C                 LDA  B   #12      Set B equal to decimal 12
0103  8B  07      LOOP       ADD  A   #7       Add 7 to A
0105  5A                     DEC  B            Decrement B by 1
0106  26  FB                 BNE      LOOP     Repeat as long as B<>0
0108  B7  010E               STA  A   ANSWER   Finally store answer
010B  7E  010B    HERE       JMP      HERE     And loop to stop
010E              ANSWER     RMB      1        Reserved for answer
                             END
```

*Listing 4.*

bers is greater than eight bits, or when a larger number is subtracted from a smaller number.

If we wanted to know which instructions affect which condition code bit, we need only look at Table 1 of last month's installment. The right side of that table specifies for each instruction whether the corresponding HINZVC bit is affected (marked with an up-down arrow) or not affected (marked with a black circle).

Likewise, Table 3 tells us which conditional branch instructions test which condition code bit.

In practice, though, we need not usually be that precise. The two most common conditional branch instructions are BEQ and BNE. In simple language, these instructions mean what they say:

BEQ—Branch somewhere if the result of the previous operation was equal to zero.

BNE—Branch if the result of the previous operation was not zero.

Next most common are the BCC and BCS instructions—branch if carry clear and branch if carry set. They are most often used after a subtraction to compare two numbers, and the simplest way to remember them is that the carry is set if the computer subtracted a larger number from a smaller one—in other words, if the answer was negative.

### A Final Example

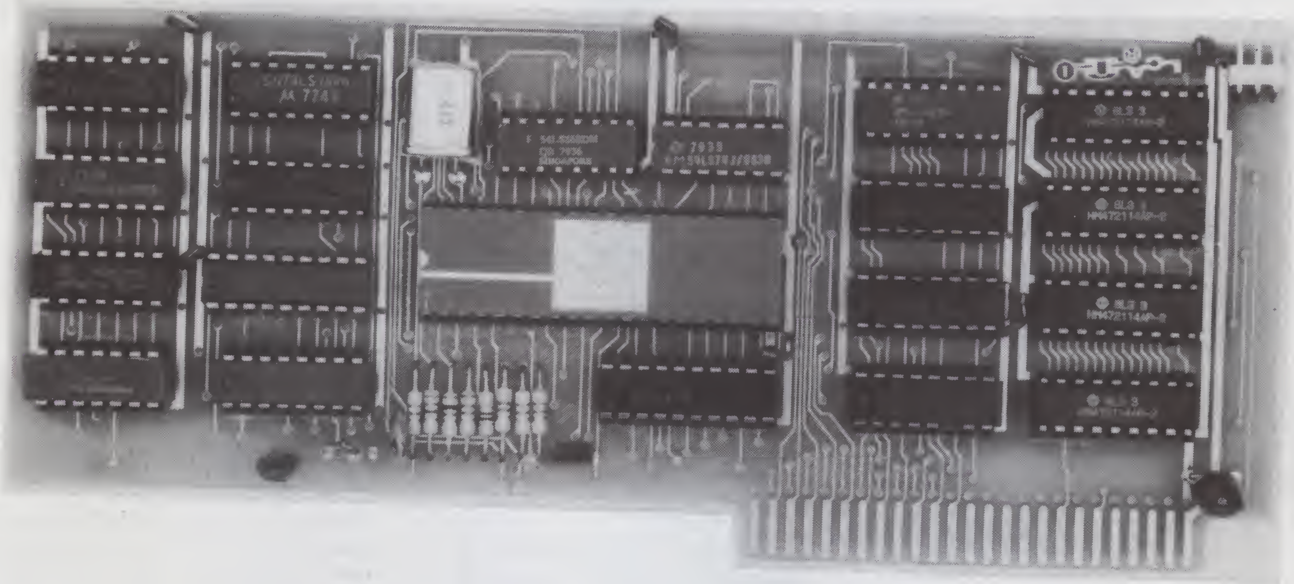
To get a bit more experience using the assembler before we go on next time, experiment with Listing 4 using the assembler. Try making a few obvious errors and see how the assembler treats them.

The program is a novice's attempt at multiplying 7 times 12. It does it by clearing accumulator A, and then adding seven to it 12 times. Accumulator B is used as the counter to count to 12; actually, it counts backwards from 12 to zero and stops when zero is reached.

See you next time.■

## FOR APPLE II AND APPLE II PLUS COMPUTERS

# DoubleVision™



## 80 x 24 Video Display with Upper and Lower Case

COLUMNS LINES

• is a hardware board that may be plugged into any slot in Apple II or Apple II Plus 32K or 48K Disks • full 128 ASCII character set, including control characters • fully programmable cursor • built in light pen capability • inverse video • full cursor control • works with 50/60Hz • has 2k of its own screen memory • has its own video output jack that must be connected to a monitor (or a high band width black & white TV thru a good RF modulator). Color TV's produce a poor display and are not recommended. • permits you to connect another monitor (or a T.V. set thru RFmod) to the Apple video output jack • displays 24 lines of 80 column text — programmable for different values • permits you to have graphics on Apple video output • video output and Apple video output may be connected to one monitor thru optional video switch • is active only when addressed for reading from or writing to • accepts lower case input from keyboard by use of escape key. (no modification required) or direct use of shift key (1-wire connection from shift key pad to DoubleVision required). • Is compatible with the latest version of various word processing software packages. Presently these include Apple-pie 2.0— Programma International, Easywriter Professional system—Informational Unlimited, Text Editor/Formatter—Peripheral's Unltd. (when ordering from these companies, please ask for versions compatible with DoubleVision). All software available from Computer Stop when released. • Peripheral's Unltd. B.I.T.S. and P.I.T.S. and Southeastern Software's "DATA CAPTURE" with Micromodem and communication card. These packages give ability to upload, transfer and download files from remote computers, and all at 80 columns! • Programma Int. latest assembler LISA V:20 will support full 80 column display • is transparent for use with Basic and Pascal • software on disk for easy modification and adaptation for different applications • completely commented source listing of software and hardware schematics available • PASCAL (optional) • becomes the console when installed In Pascal • Permits 80 column text processing with full upper/lower case while using Pascal's editor • must be plugged into slot 3 when operating with Pascal

**Available now at your local computer store. . . . . . . $295.00**

Call Computer Stop for Store nearest you

Shipping, Insurance, Handling, extra

Calif. Residents add 6% Sales Tax

*Apple is a Registered TM of Apple Computers, Inc.

*Dealer inquiries invited.*
*Contact:*

COMPUTER STOP CORP.
2545 West 237th St.
Suite L
Torrance, CA 90505
539-7671

The Computer Stop
16919 Hawthorne Blvd.
Lawndale, CA 90260 ✓283
(213) 371-4010

**MON. - SAT.**
**10-6**

✓ Reader Service—see page 257

# Hard Copy for the OSI Challengers

*This simple modification accommodates both hard copy and cassette I/O for the Challenger IIP.*

*Stephen Mendelsohn*
*144-25 33rd Ave.*
*Flushing, NY 11354*

The Ohio Scientific Instruments Challenger IIP is an excellent introduction to microcomputing. It has a keyboard, cassette support system, video output system, 4K of low power RAM, an excellent 8K BASIC in ROM by Microsoft and a fast 6502. My favorite characteristic is that you can put it under your arm and walk away with a free hand. It fits the bill as a portable micro to take to work with me. Why wait for the IBM system to become available for small programs when you can have a Challenger right on the desk?

### As Easy Hard-Copy *Modification*

This idea carried me through my first six months of working with the micro. Then the day came when I had put in a program to do an alphanumeric sort, and I realized that I did not have any way to print the thing. Hard copy could not be had with the unit as delivered from my source.

I put in a call to Johnson Computer, my source, in Medina OH. After much discussion with Phil and Kevin Johnson we came to the conclusion that the best way to get a high- and low-going signal out to the world would be the cassette system already installed. Into the OSI documentation I went.

I am using the OSI 440B "super I/O board." This board latches the data out of the micro into a 6011-type UART, which then drives a 555 and 7490 divider chain to derive a Kansas City Standard audio-cassette tone.

It occurred to me that the UART was clocked with the 555, so if I simply slowed down the 555 with a resistor I could get the speed down to the 110 baud necessary for a dot-matrix printer. The software resident in the OSI 65 V PROM monitor would take care of getting the data to the UART and the resistor would slow it down . . . but now to get it out.

Back into the schematics I went. I noticed that in the serial, non-video systems OSI supplies they drive the printer with two chips. I decided to give it a try.

Serial data coming from the UART's transmit serial output pin (TS0), pin 25, was run through a single section of 7404 and a single section of 7417 to handle the current sinking, and the output of the 7417 showed data at the correct level. And the best thing was the cost—about $0.55! I wisely decided that 55 cents was not a lot to spend for a serial port and went about taking the wiring off the breadboard and transferring it to the 440 board.

### Construction Notes

First, mount two 14-pin sockets fairly close to each other. Wire 5 V dc to both sockets at pin 14, with ground at pin 7. Run a wire from pin 25 of the 6011 socket to the input pin on any of the 7404 inverters. Take its corresponding output and wire it to the 7417. Bring the corresponding output of the 7417 to either the auxiliary output connector on the board or to a DB25-type socket that will mount on the back of the Challenger IIP.

If you have any other OSI model, just wire the output of the 7417 to any convenient connector. You must also run a wire from the +5 V dc supply through a resistor of about 220 Ohms to the other side of the connector. These two wires will form the pair that will be connected to a hard-copy device. I suggest checking to see that the current in the loop is 20 mA. If not, just adjust the 220 Ohm resistor to get a value of 20 mA.

### Speed Conversions

I had serial pulses out at 20 mA, but what about speed? The cassette clock (the aforementioned 555) ran at the necessary 16 times the 300 baud rate for the audio cassette. A check with a borrowed frequency counter showed that, sure enough, at pin 3 of the 555 the frequency was 4800 Hz. I had to lower it to the right frequency, 1760 Hz for 110 baud.

According to the schematic, the pin 7 connection went to VCC through, first, a 10k pot and then a fixed 1k Ohm resistor. At the junction of these two

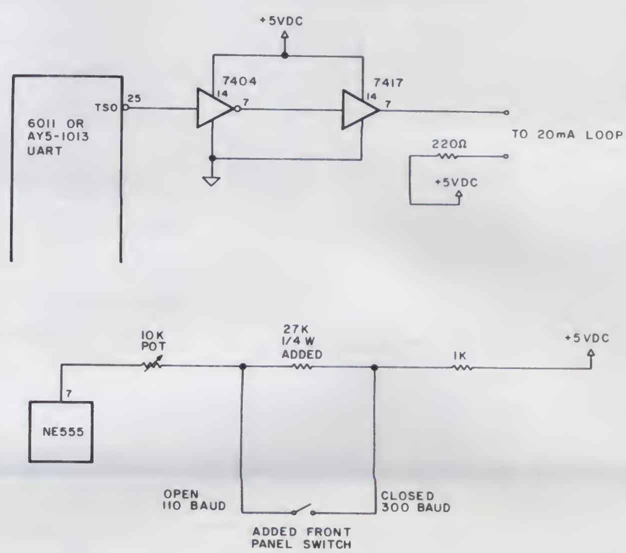



*Fig. 1. Hard-copy circuitry.*

components I unsoldered the 1k Ohm resistor and lifted it off the board. I then soldered a wire from its former land on the board to one side of a 27k Ohm 1/2 Watt resistor.

A check with the counter showed that this caused the 555 to run at 1763 Hz. Don't worry about the 3 Hz difference. So far so good . . . but I did not forget my original requirement for both hard copy and a cassette system. The simple answer was an SPST switch that shorted the resistor to give 300 baud and in the open position would allow the system to run at 110 baud.

A drill and 5 minutes' work finished this chore, and I had a mini toggle switch located on the far right of the front panel above the keyboard. Proper labeling was added with a Dymo, and I had my hard copy/cassette system. Total cost was $2.25 . . . still a bargain as serial ports go.

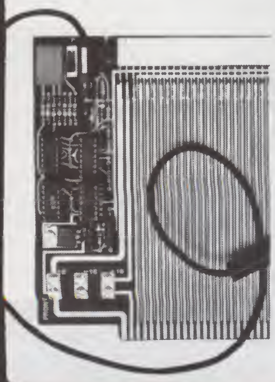
After all of this exertion I timidly hooked up a 33 KSR and was happy to see that it did indeed provide the necessary hard copy when the CSAVE was inserted. I have found that I am adding it to more and more programs as a way of doing necessary program calculations. Then, if all is well with the program and answer, typing CSAVE causes it to come out as hard copy . . . or flip the switch and enter or print to cassettes. I should also add that this has been an invaluable help in debugging.

**Final Notes**

This system is not unique. The idea for the circuitry came from OSI; the added components came from the junk box. If you want to add such hard-copy circuitry to any machine, just take the TS0 of your UART and buffer it with a 7404 and add the 7414 to handle the current. Slow down the UART's clock and you are ready to go. As you can see from Fig. 1, it is no genius circuit, just some good adaption. If you have been looking for such a method, give this a try. ■

# MULLEN Computer Products

## S·100 EXTENDER/LOGIC PROBE

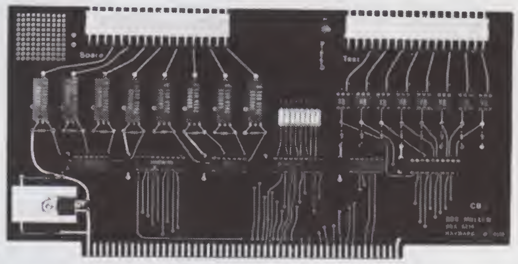


- New interlaced ground and signal traces, improves performance, reduces noise, with the new high clock frequency boards
- New brighter display, makes this very handy logic probe easier to use
- New proposed IEEE buss edge connector label, with all the fine quality documentation you expect with Mullen kits.
- High quality FR-4 board is double sided with plated thru holes and solder-masked for easy kit assembly
- Gold on all mating connector surfaces for better electrical contact
- Formed connector leads for easy scope probe attachment
- Jumper links in power lines makes current measurement and fusing easy
- Large "kluge" area lets you build and test your own circuits

**TB-4 EXTENDER/LOGIC PROBE**
**$59. Kit $79. Assm/tested**

## S·100 CONTROLLER BOARD

- **8 reed relay - OUTPUTS**
- **8 opto-isolated - INPUTS**
- **256 selectable port addresses**



Our S-100 CONTROLLER is used in laboratories, at universities, and in industry, in hundreds of applications, and may be the answer to your control problem. Complete programming and operating instructions included.

For higher power applications a 500W AC POWER MODULE is available for $15.

**CB-1 CONTROLLER Kit $129.**
**Assm/tested $179.**

**MULLEN Computer Products**

## M-80 CONTROL BOX

**TRS·80* accessory**


The **M-80 OCTOPORT** is a simple to use interface for the **TRS-80 COMPUTER.** You can **control 8 external devices and sense 8 external conditions.** Each output uses a reed relay and each input an opto-isolator to electrically isolate your TRS-80.

One or more controllers can be connected to either the interface connector or the screen printer connector.

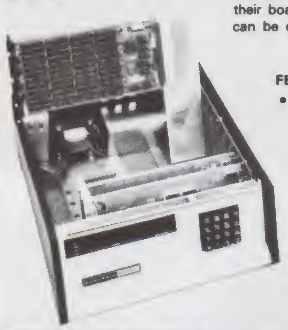
**Each OCTOPORT is shipped completely assembled, tested and INCLUDES the interconnector cable, a UL approved power pack, and a 1 year warranty.**

**M-80 OCTOPORT CONTROLLER**
**$159. Assm/tested**

Use your TRS-80, and our M-80 control box to program control energy savings devices at home or in your business. Send for our free application notes today.

*TRS-80 is a trademark of Tandy Radio Shack Corp.

## H8 EXTENDER BOARD



Our HTB-0 lets H8 owners troubleshoot their boards faster and easier. Each board can be extended above the computer for complete access to all circuits and components.

**FEATURES**

- Sturdy 3/32" board
- Molex 25-pin edge connectors with formed leads for easy scope probe attachment
- Jumper links in power lines makes current measurement and fusing easy

**HTB-0 H8 EXTENDER**
**$39. Kit**

*H8 is a trademark of Heath Company.

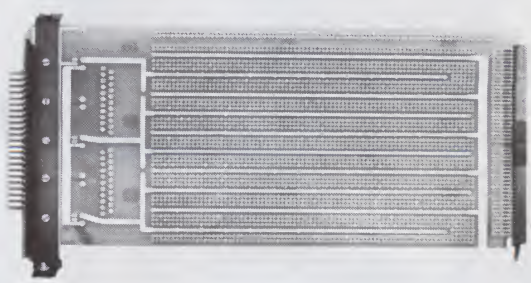
**KLUGE BOARD DESIGNED WITH YOUR PROTOTYPING PROBLEMS IN MIND.**

## H8 PROTOTYPE BOARD

Now available for the Heathkit H8

- Full-sized FR-4 board with heat sink/mounting brackets, buss connectors and polarizing key
- Designed for ease of external cable connection
- All plated thru holes .042" on .1" centers, power and ground traces

**HKB-1 H8 PROTOTYPE BOARD $30. Kit**



PROTOTYPE KIT ACCESSORIES: if you wish to buy any of these accessories for your kit, please list parts and add price to total order. These parts may be ordered at any time, but an additional $1.50 shipping and handling will be charged. . . if ordered separately.

| | | | |
|---|---|---|---|
| PRICES: | $ 5.00 | (1) | 44-pin edge/cable connector |
| | $ 2.00 | (1) | 5 Volt regulator with (2) 39uF capacitors |
| | $ 1.00 | (1) | 25-pin Molex connector (90° male) |
| | $ 1.00 | (1) | 25-pin Molex connector (female) |

✓37 **MULLEN COMPUTER PRODUCTS**
**BOX 6214, HAYWARD, CA 94544**

OR PHONE (415) 783-2866 · VISA/MASTERCHARGE ACCEPTED.
INCLUDE $1.50 FOR SHIPPING & HANDLING.
CALIFORNIA RESIDENTS ADD TAX.

**Order Direct or Contact your Local Computer Store.**

# The Sinclair ZX-80 Microcomputer

*It's for real.*

*Stanley J. Wszola*
*Manager, Documentation Department*
*Instant Software, Inc.*
*Peterborough, NH 03458*

When I first saw the ZX-80, I said, "This is a computer?" It looked far less impressive than most of the hand-held electronic games—it weighed only 12 ounces, and was just slightly larger than pocket-size at 6½ × 8½ × 1½ inches.

The computer comes with a 128-page instruction and BASIC programming manual, cables for loading and saving your programs with a cassette recorder, a "mains adapter" (a 9 V dc power supply) and a switching adapter and cable for connecting the computer to a television set (channel 2).

When I opened the case, I saw the built-in rf modulator. There is no direct video output. The display is 32 characters by 24 lines (black on a white background—a nice touch). The picture on a standard black and white television is only fair, comparable to the OSI Superboard. The inside of the case is sprayed with metallic paint to cut down on rf interference.


*The ZX-80.*

The keyboard is the touch-sensitive, plastic overlay type. Most of the keys have triple functions.

The entire computer comprises only a handful of chips. There are, of course, your standard Z-80A, the input and output buffers, 1K of RAM and one ROM chip that includes the character generator, the monitor and a 4K Integer BASIC. *Considering the* functions that this computer must perform, the Sinclair people have done a good designing and packaging job. I am impressed.

Because the design is so simple, the poor little Z-80A chip has a lot of work to do. This becomes apparent whenever you type in a program. The screen will flicker whenever there is input from the keyboard or output from the computer. Initially this was annoying, but after using the computer I watched for the flicker as an indication that my input was entered correctly.

Back in 1964, when Dartmouth BASIC was only a gleam in the eye of John Kemeny, little did he know that it would still be used 16 years later. Of course, it's not exactly the same—the ZX-80 doesn't have matrix instructions or other embellishments (see Table 1). But there are other commands, such as PEEK, POKE, USR, RAND (a pseudo-random number generator) and EDIT (an easy-to-use program editing function), that make this micro a powerful handful.

Most of the commands are entered with a single keystroke by using the shift key. This saves a lot of time when you are trying to type on the tiny little keyboard. (I haven't been so annoyed with a keyboard since I had to work with the old PETs.)

The selection of BASIC commands is more than sufficient, if you have only 1 or 2K to work with. But, the designers have a trick up their collective sleeve. The commands

that are entered with a single keystroke each take up only one byte of memory space. You can squeeze a lot of programming into the available memory.

I have been assured by those who know that you can do machine-language programming by using the PEEK, POKE and USR commands. I didn't try because I do most of my work with FORTRAN and BASIC. (I start playing Bach fugues in my head when the talk turns to memory locations and hex code.) An experienced machine-language programmer, familiar with the Z-80 chip, could have an interesting time with this computer.

Because the BASIC is so simple, the Sinclair people have slipped another goodie into their computer. As you write a program, the computer will examine each line for syntax errors and change the cursor to an S when it finds one. The computer will not accept a line with an error in it. And, when the output of a program is displayed on the screen, you might see an error code, telling you what, if anything, went wrong with your program. (Watch that syntax, or Mama ZX-80 will lay an error code upside your CRT.) These features make writing and debugging a program easy even for a beginner.

Single key BASIC commands:

| | | | | | |
|---|---|---|---|---|---|
| NOT | AND | THEN | TO | HOME | RUBOUT |
| NEW | LOAD | SAVE | RUN | CONT | REM |
| IF | INPUT | PRINT | LIST | STOP | DIM |
| FOR | GOTO | POKE | RAND | LET | EDIT |
| CLEAR | CLS | GOSUB | RET | NEXT | |

User entered BASIC commands:

| | | | | | |
|---|---|---|---|---|---|
| CHR$ | STR$ | TL$ | PEEK | CODE | RND |
| USR | ABS | | | | |

*Table 1.*

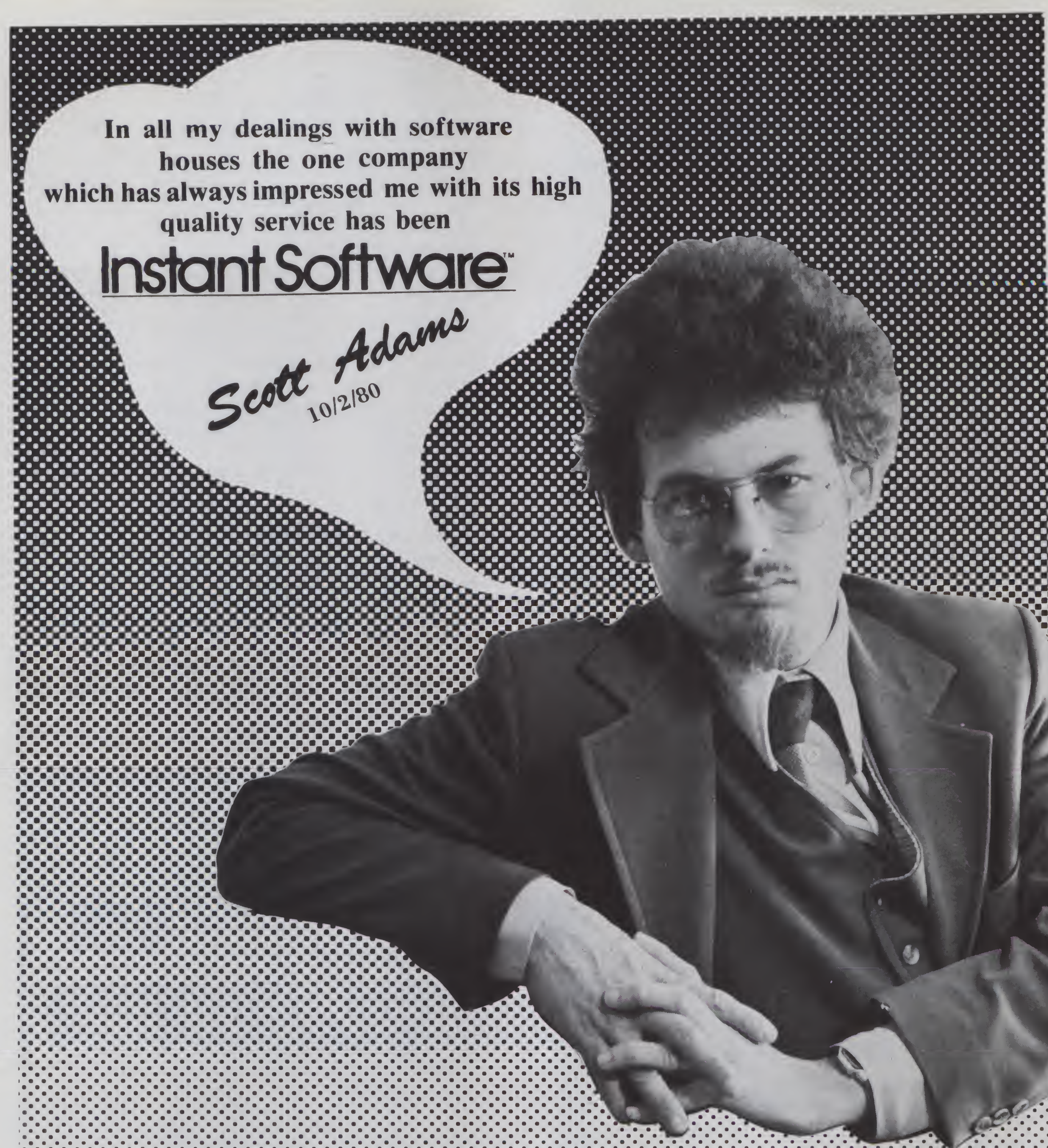
The instruction book that comes with the ZX-80 is first-rate. The instructions assume that you are a rank beginner and take you from the initial power-up of the computer all the way to writing your own programs. Individual chapters explain the function of various commands and the logic behind them. There are many sample programs for you to enter and run. The instructions encourage you to experiment with the programs.

A colleague remarked that if you wanted to learn BASIC, it would be cheaper to buy the ZX-80 than it would to take a college course. Not only would you have access to the computer whenever you wanted it, but you could keep it or sell it when you finished.

The Sinclair ZX-80 lists for $199.95. (I've also seen advertisements for the MicroAce computer, which bears a striking resemblance to the ZX-80, for $149.00 in kit form.) Sinclair plans to release an 8K floating-point BASIC and a 16K memory expansion (the ZX-80 has an expansion connector at the rear of the case). There is also a new publication devoted to the ZX-80 called *Syntax ZX80*.

### Conclusions

The ZX-80 is a real computer and an excellent value, but only if you are new to microcomputers or an experienced programmer. The beginner can take full advantage of the instruction manual and only an experienced Z-80 programmer can get the most from so simple a microcomputer. ■




SCOTT ADAMS,
President of
Adventure International
and author of the
"Adventure" Series.

# Instant Software™

PETERBOROUGH, NEW HAMPSHIRE 03458   603-9247296

# Instant Software™

# Now Sells The Adventure Series*

YOU CAN CALL 1-800-258-5473 TO ORDER THESE NEW INSTANT SOFTWARE OFFERINGS. OR STOP BY ONE OF OUR 300 DEALERS THROUGHOUT THE U.S.A. AND THE WORLD, FOR PERSONALIZED SERVICE.

*AND MORE

## ADVENTURE!

**ALL 3 PAKS**
**TRS-80 32K**
**Apple 48K**

1) **ADVENTURELAND** - You wander through an enchanted world trying to recover the 13 lost treasures. You'll encounter wild animals, magical beings, and many other perils and puzzles.
**TRS-80 Tape Order No.5501R**

2) **PIRATE'S ADVENTURE** - "Yo ho ho and a bottle of rum...."You'll meet up with the pirate and his daffy bird along with many strange sights as you attempt to go from your London flat to Treasure Island.
**TRS-80 Tape Order No.5505R**

3) **MISSION IMPOSSIBLE ADVENTURE** Good morning, your mission is to....and so it starts. Will you be able to complete your mission in time? Or is the world's first automated nuclear reactor doomed?
**TRS-80 Tape Order No.5507R**

3 PAKS
Apple
No.5503AD
TRS-80
No.5504RD

4) **VOODOO CASTLE** - Count Cristo has had a fiendish curse put on him by his enemies. There he lies, with you his only hope.
**TRS-80 Tape Order No.5508R**

5) **THE COUNT** - You wake up in a large brass bed in a castle somewhere in Transylvania. Who are you, what are you doing here, and WHY did the postman deliver a bottle of blood?
**TRS-80 Tape Order No.5511R**

6) **STRANGE ODYSSEY** - Marooned at the edge of the galaxy, you've stumbled on the ruins of an ancient alien civilization complete with fabulous treasures and unearthly technologies.
**TRS-80 Tape Order No.5512R**

3 PAKS
Apple
No.5509AD
TRS-80
No.5510RD

7) **MYSTERY FUN HOUSE** - Can you find your way completely through the strangest Fun House in existence.
**TRS-80 Tape Order No.5513R**

8) **PYRAMID OF DOOM** - An Egyptian Treasure Hunt leads you into the dark recesses of a recently uncovered Pyramid.
**TRS-80 Tape Order No.5516R**

9) **GHOST TOWN** - Explore a deserted western mining town in search of 13 treasures from rattlesnakes to runaway horses, this Adventure's got them all!
**TRS-80 Tape Order No.5517R**

3 PAKS
Apple
No.5514AD
TRS-80
No.5515RD

Prices: All Tapes 16K . . .$14.95
All 3 Paks Disk . . $39.95

## MORE*

**STAR TREK 3.5:** Get those Klingon's! The newest, most sophisticated Star Trek version by the Grand Master - Lance Micklus. The top program of it's kind available.
**TRS-80 Mod.1 L.II 16K**
**Order No.5518RD $19.95 Disk**
**Order No.5519R $14.95 Tape**

**SLAG:** War gaming at it's best. Real time graphics combined with long range planning make this an exciting, fascinating game.
**TRS-80 Mod.1 L.II 16K**
**Order No.5520R $14.95 Tape**

**ASTEROID:** The real time, high resolution graphics game that's a smash hit at Arcades all over the world. Three levels of difficulty. Save your quarters.
**Apple 2 Disk**
**Order No.5521AD $19.95**

**KID VENTURES:** #1 Little Red Riding Hood. Allows your child to interact with the story, learning as they go. Designed for readers and non readers alike. Includes sound and play along cassette tape.
**TRS-80 Mod. 1 16K**
**Order No.5522R $14.95 Tape to Disk**

**GALACTIC EMPIRE:** Good strategy space war game. You as commander of Galactica's Imperial forces, must capture and hold the 20 inhabited worlds of the Galactic System.
**TRS-80 Mod. 1 16K**
**Order No.5523R $14.95 Tape**
**Order No.5524RD $19.95 Disk**

**GALACTIC TRILOGY:** Special all three games of the Trilogy - Galactic Empire, Galactic trader, and Galactic Revolution all on one disk at a special savings.
**TRS-80 Mod. 1 16K**
**Order No.5525RD $39.95**

★ **INTERACTIVE FICTION:** The computer sets the scene with a fictional situation. Then you become a character in the story. When its your turn to speak, you type in your response. The resulting dialogue and even the plot will depend on what you say.

**SIX MICRO STORIES:** An introduction to interactive fiction. Involves the reader in a variety of situations from being a spy to a pilot in a doomed 747 and more.
**Order No.5526RD $14.95 Disk TRS-80 Mod. 1 16K**

**LOCAL CALL FOR DEATH:** A detective story considerably more challenging them the above program.
**Order No.5527RD $19.95 Disk TRS-80 Mod. 1 16K**

**TWO HEADS OF THE COIN:** Psychological Mystery set in the London of Sherlock Holmes. Most challenging of all. Will tax your observational and imaginitive skills.
**Order No.5528RD $19.95 Disk TRS-80 Mod. 1 16K**

## We Guarantee It!

**Instant Software Guarantee**

OUR PROGRAMS ARE GUARANTEED TO BE QUALITY PRODUCTS. IF NOT COMPLETELY SATISFIED YOU MAY RETURN THE PROGRAM WITHIN 60 DAYS. A CREDIT OR REPLACEMENT WILL BE WILLINGLY GIVEN FOR ANY REASON.

**DEALERS:**

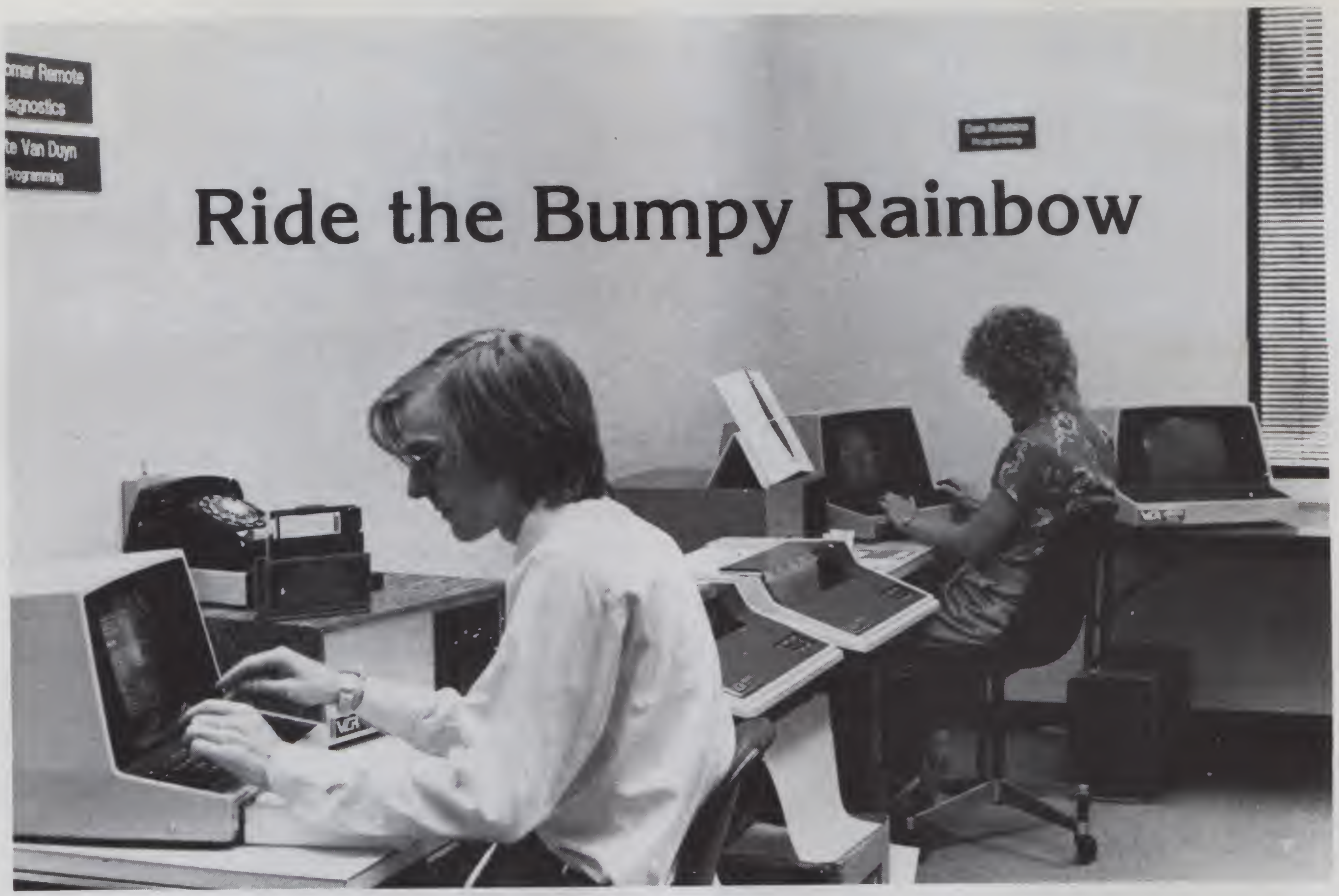
Instant Software is offering you SUBSTANTIAL discounts when ordering these top selling programs. Just call toll-free 1-800-532-5474, to place your order. WE SHIP RIGHT AWAY!!! Call us, if you need any further information.

# Instant Software™

PETERBOROUGH, NEW HAMPSHIRE 03458 603-924-7296

Reader Service—see page 257

# Ride the Bumpy Rainbow



*Frank J. Derfler, Jr.*
*PO Box 691*
*Herndon, VA 22070*

*It is important for a systems house to have plenty of equipment on hand for development and customer back-up. Two more complete systems are on the opposite wall.*

Is there a pot of gold waiting for those who can integrate microcomputer systems into small businesses? You bet. Is it an easy thing to do? No way!

Micros and small businesses are meant for each other, but getting them together involves many problems. Small-business proprietors are hassled, harried and worried. You need a special kind of sales and development technique to provide them with cost- and management-effective microcomputer systems. You have two paths you can take.

First, you can open a software house. These are custom design shops that usually deal with a specific brand or type of computer hardware.

Second, you can start a systems house. These provide the complete software, hardware and systems management services (also known as turnkey services) to their customers.

As a microcomputer software author, you can make money selling copies of your software and writing some custom programs like a big-time software house (Instant Software is aimed at helping you do just that). But the real pot of gold will be found by those who ride the bumpy rainbow and take the systems house approach.

**Systems House Setup**

You'll get a better idea of what running a systems house involves by studying one. Validata, Inc., of Montgomery, Alabama, offers a wealth of information and suggestions.

Validata, like many enterprises in the microcomputer world, is a partnership. Warren Philips is the business manager and practical applications mentor, Bob Brooks is the programmer, and Pete Van Duyn does system integration and hardware. They also rely on a full-time sales person and administrative person.

The partnership is a key to Validata's success. Only rare individuals are well-rounded enough to successfully carry all aspects of a business alone. Validata's structure relies on the talents of several people.

Validata began when Philips wanted to give computer support to a snack food distributorship he runs. He hired Brooks part-time to investigate the possibilities of getting a computer to keep track of inventories and orders.

Even though Philips was intimately familiar with the business and Brooks was an experienced programmer, it took nearly two years to develop a fully debugged and reliable system. Despite optimistic estimates, the road to the pot of gold can be long.

Work at Validata began with the programmer and businessman teaching each other their trades. This is a good approach but requires more than the typical amount of interest in computers on the part of the businessman. It's usually easier to teach a programmer the business than to teach a businessman how to program.

Since the brain of a programmer can be stretched only so far, most systems houses will find themselves specializing in systems for certain specific small businesses. Validata has made good progress in providing inventory and accounting systems for snack food distributors in the South.

Finding the right hardware to offer in your systems involves many problems. Computer owners usually have a favorite system, but their reasons for liking that hardware might not hold up when measured against other considerations.

What software is already available? Are delivery times reliable? How dependable are the systems? Can they be expanded to meet future growth needs? What terms will

**Automated systems usually save time, will probably make operations more efficient and will solve problems in paperwork. But they seldom save any money.**

the manufacturer settle for? Are the displays wide enough and keyboard strong enough to meet business needs?

The people at Validata settled on the North Star Horizon. North Star BASIC offers a considerable library of business, scientific and statistical software. Delivery is reliable, and expansion potential is excellent. Validata chose the TI810 printer for similar reasons.

Validata also had to consider hardware maintenance. They simply couldn't allow a business to miss a payroll because of a bad disk drive.

Validata has an excellent method to service equipment at distant locations: remote diagnostics via telephone. Each Validata installation includes a leased telephone modem. A customer with a system problem can call Validata, describe the problem and run a special diagnostics program. Brooks or Philips can run various subroutines for hardware and examine all of the software on disk. They can also monitor the customer's keyboard operation and correct problems with two-way dialogue.

This remote software wasn't easy to write, but it has saved many thousands of dollars in unneeded trouble calls. Well over 80 percent of the trouble calls, says Brooks, are operator or disk errors.

Both Brooks and Philips speak with anguish about the environment some of their computers have to face. Dust, cigarette smoke and coffee cup rings abound. Still, surprisingly little data is lost because of damaged disks.

Validata stresses the importance of backup disks. This soon becomes a habit for most operators. The company solves many problems simply by trying the backup copy.

**Selling Yourself**

Validata has one major guideline when they approach a potential customer. They don't sell the computer—they sell help. They sell inventory, billing and automatic typing systems, but avoid the loaded word "computer." Computer people sometimes don't realize that many people are frightened by computers.

From my own experience, I can add that it isn't wise to tell your customer that the system will save money. Even the Federal government has stopped trying to justify computers this way. Automated systems usually save time, will probably make operations more efficient and will solve problems in paperwork. But they seldom save any money. If your customer has a cash flow problem, a computer probably won't help. (The exception is when the cash flow is down only because outgoing billing is late or poorly done.)

In addition to the computer itself, Validata sells its personal service. An automatic inventory system won't work perfectly from the start—problems will inevitably arise. Validata does a lot of time-phasing, planning and handholding. Each account is a little different. Some customers might hire temporary help to load inventory data. Others find vacation and slack times to make the change. With proper planning and introduction, Validata helps the automated system make friends for itself.

**Other Tips**

Here are some other hints that might help you on your way:

- Pay special attention to location. Rent and office furniture are expensive, so the temptation to cut overhead is strong. But if you are selling to other small-business managers, you must at least look competent. A systems house doesn't depend on customer flow and therefore doesn't have to be centrally located, but the facilities do have to be adequate.

When you are on your feet and ready to go big time, look for bargain rentals on the outskirts of town. Some new buildings will give low leases to tenants who sign up before construction is complete. Budget enough capital to provide a decent working facility.

- Don't give up your daily job and mortgage the house on a short-term note. Success is probably further away than you think. Moonlight before you try to go into the computer business full time.
- Find a business that you can understand and that has many operating locations. Learn that business from top to bottom. You will have to see, touch and understand every part of it if you are to give the customer maximum computer support.
- Don't overlook hardware maintenance. Providing real service means you have to stock circuit boards, parts and disk drives. But you also have to be alert to the operator errors that may look like a system problem. Give deep consideration to maintenance and diagnostics for any systems you sell to small businesses. They can't afford any down time.
- Sales of computer systems for small-business support depends on the quality of your product and how well you scoped out the industry you intend to support. If your system is really good, it will sell through word of mouth. Articles in trade journals and newsletters can bring in a lot of business. You will find other contacts at conventions and among other persons who sell services or supplies to the line of business you want to support.

*Bob Brooks and Pete VanDuyn are important parts of the successful Validata, Inc., team, but as this scene shows, there is still mundane work to be done. Here they appear to be trying to figure out whose hand is which while making up a multi-pin cable and connector.*

**Funding**

You simply have got to have money from some source to start.

How much? More than you think. You will certainly have to pay on order for the system you are going to sell your customer. That probably means at least $6000–$10,000 (depending on the printer) for openers.

You should have at least one development system available. Let's say another $6000. If a system for program development is already available, you are fortunate, but make sure it is completely compatible with your customer's system. It is ridiculous to expect your customer to let you use his system to work out software updates and changes.

You must also provide good operating manuals and documentation. Add several hundred dollars for binders, printing, cards and stationery.

All of this is needed before you can think about moving to a permanent business location. As a rule of thumb, you need at least $15,000 in credit and assets before you complete your first sale.

Take the entire project in steps. Find the right business to support first. Learn all you can about that business. Write software on a developmental system bought with your own money. Show the software to the businessman you are supporting and then look for credit for further developments and equipment.

That credit can come from many sources. Bank loans are expensive, but a bank might pay attention if the businessman you are going to sell a system to speaks favorably about you. Look to acquaintances (not friends) for help.

There are many people with money to invest. If you have a good product, you will find money coming to you. When you get your funds, guard every penny and look out for surprises.

When I visited Validata, Philips and Brooks were wondering what to do with 11 TI810 printers. TI had decided to ship them their entire long-term order at once. If they had come COD, it could have been very exciting.

The people at Validata are pretty close to opening the lid on the pot of gold. The trip took several years of work by some talented people. They specialized, learned and planned. You can successfully ride the same bumpy rainbow with planning and perseverance.■

# Innovative Tech's Analog-to-Digital Converter

*For SWTP 6800 owners, the AD-68 might fill the bill.*

*Dr. Gordon W. Wolfe*
*Physics Department*
*University of Mississippi*
*University, MS 38677*

We live in an analog world. Nearly everything around us can be measured as a number.

But computers are digital. All data is represented by a series of ons and offs. We can group a series of these on/off data pieces together into a byte or word, or even into a floating-point collection to represent virtually any number we choose, but it's still basically on/off.

So when a computer measures physical quantities, these quantities must be converted into a series of on/off bits that a computer can understand and process.

The usual way of doing this is shown in Fig. 1. Say, for example, that you want to measure the temperature of something. First you need to convert the quantity being measured into an electrical signal. This is handled by a *transducer;* in this case, perhaps a thermocouple or thermistor. (A thermocouple will produce a higher voltage at its output for a higher temperature at its junction.)

This electrical signal, or analog voltage, must be converted to a series of on/off bits by an analog-to-digital converter (ADC). The computer receives the ADC's output for processing.

The ADC is the most critical part of the measurement apparatus, and it is also the hardest to design and build. Much has been written about the various ADC designs, and the benefits and shortcomings of each. An ADC chip can cost as little as a few dollars, or commercially built high-precision ADCs can cost tens of thousands of dollars.

For those of us who own the SWTP 6800, or any of the other SS-50 bus computers, Innovative Technology (510 Oxford Park, Garland, TX 75043) has an excellent and inexpensive ADC. The AD-68 can quickly measure eight separate analog voltages, and plugs directly into an I/O slot on the SS-50 bus. It costs only $39.95, shipping included.

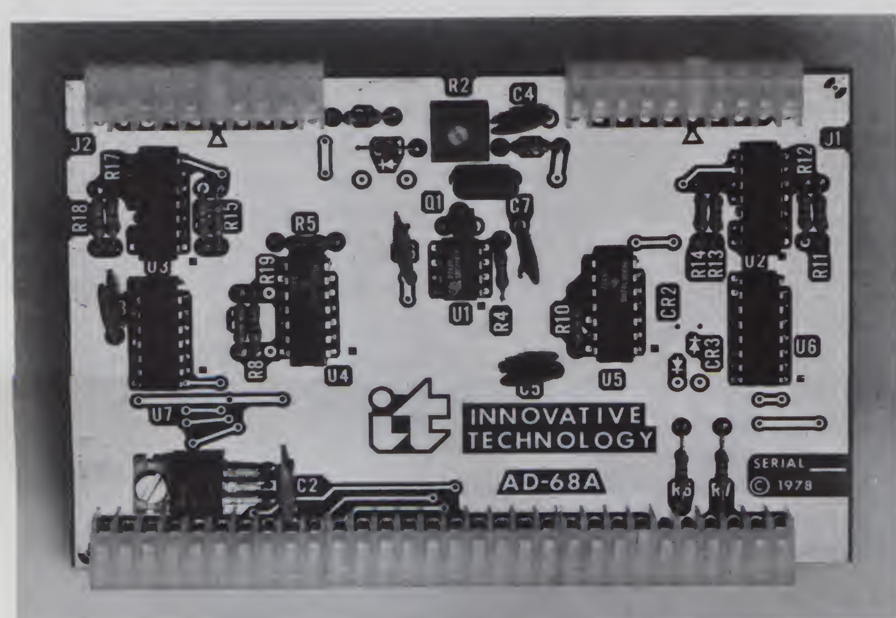



*Photo 1. The analog-to-digital converter from Innovative Technology.*

**Arrival**

The ADC is completely assembled and tested. It comes with quality parts on an excellent silk-screened circuit board (Photo 1), and the board includes plenty of grounding plate. The documentation is excellent, and includes complete instructions for connection, a description of the circuit and schematic, and assembly-language and BASIC-language driver programs, either one of which may be used to drive the AD-68. The


*Fig. 1. Measuring physical quantities for the computer.*

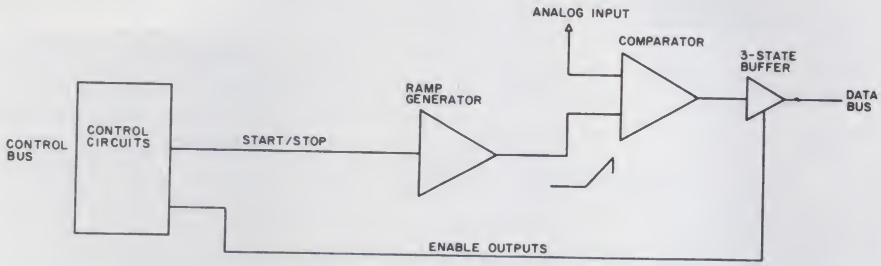



*Fig. 2. Block diagram of the AD-68.*

unit worked perfectly the first time I used it.

Fig. 2 is a block diagram of the AD-68. The unit works on a simple principle, using the single-ramp method of conversion. Counting and timing is completely under computer control. The computer begins to measure voltages and convert them to a digital number by starting the ADC. This causes a ramp generator to begin outputting a linearly increasing voltage.

The computer polls the output of a comparator, which changes state when the ramp voltage becomes higher than the voltage being measured. When the change of state occurs, the computer stops a count in its memory. The resulting count is the digital number corresponding to the analog voltage. The ADC may be calibrated through a potentiometer mounted on the board.

In general, the ADC operates satisfactorily. With an input from a precision voltage source of 2.500 ± .001 volts, the ADC measures 250 counts, plus or minus one count. (A count corresponds to 0.01 volt, and is therefore the precision of the ADC.) A simple program to cycle through a read of the ADC 10,000 times and then perform a simple statistical analysis on it showed that, for the same precision input voltage as above, the output number averaged to 250.0 decimal, with a standard deviation of 0.7 decimal.

The ADC has eight-bit resolution, and has eight separate inputs, so that eight separate voltages may be measured by the ADC. +5 V and ground voltages are also provided at the output connector.

### Shortcomings

The AD-68 has shortcomings, but as long as it is used for the purpose for which it was designed, these won't be a problem.

First, because the counting is done by the processor, only one input can be measured at a time. Fast coincidence measurements cannot be done. *Simultaneous* measurements are not possible, but measurements can be made as quickly as 7 ms apart.

Second, the ADC is slow. It requires up to 6.35 ms for a conversion. This will limit the number of conversions that can be made in a second, and also precludes the use of the AD-68 for measuring high-frequency ac. The device is definitely a dc-only measuring unit. It could not be used for speech-recognition or fast pulse-height measurement, and the unit has no provision for peak sensing.

Third, and most important, it has a designed-in upper-voltage limit of only +2.5 volts. This means that the device is not fully useful in measuring the output of TTL, CMOS or op amps. You could, of course, work up a simple circuit to convert the range of voltage being measured to the 0 to 2.5 volt range. Note that anything being measured has to be supplied by a 2.5 V power supply, reasonably well regulated. My Motorola reference manual, which supposedly lists all JEDEC numbers, only lists *one* 2.5 volt zener diode.

Fig. 3a is a diagram of a regulator that can be adjusted to provide a steady 2.5 volts at up to 200 mA, using a +5 V TTL power supply as the input voltage. The +5 V terminal on the AD-68 output connector may be used for this. Fig. 3b shows how this regulator may be connected to joysticks or push buttons for sensing events or joystick position.

Listing 1 provides an assembly-language program for the 6800 which acts as a driver for the AD-68, and makes it easy to read data from it. The subroutine AD68 at $DD2B is the driver routine for the AD-68. This is slightly different from the driver routine



Reader Service—see page 257




supplied with the device, so that it can be placed in EPROM. The input channel to be accessed is placed in BITNO at $A086 as the bit number of the channel to be accessed—to access channel 4, a $08 is placed in BITNO (all zeros except for a one in the fourth bit from the right). The digital equivalent of the analog voltage at input 4 will be placed in DATA at $A087. The routine assumes that the AD-68 has been placed in I/O slot 3 at $800C, and that RAM is available at $A080 to $A090.

```
                        *
800C                    PORT3   EQU  $800C
A018                    XTEMP   EQU  $A018
A085                    INTRUP  EQU  $A085
A086                    BITNO   EQU  $A086
A087                    DATA    EQU  $A087
                        *
DD00                            ORG  $DD00
                        *
                        *DRIVER FOR ALL 8
                        *CHANNELS OF AD68
                        *DATA IN A087-A08E
                        *
DD00 C6 08              AD68C8  LDAB #8
DD02 CE A0 8E                   LDX  #DATA+7
DD05 FF A0 18           NEXT1   STX  XTEMP
DD08 37                         PSHB
DD09 F7 A0 86                   STAB BITNO
DD0C 8D 0E                      BSR  BIT
DD0E B6 A0 87                   LDAA DATA
DD11 FE A0 18                   LDX  XTEMP
DD14 A7 00                      STAA 0,X
DD16 09                         DEX
DD17 33                         PULB
DD18 5A                         DECB
DD19 26 EA                      BNE  NEXT1
DD1B 39                         RTS
                        *
                        *AD68 CHANNEL NO IN B
                        *TO BIT IN A
                        *NO OF BIT IN BITNO
DD1C 4F                 BIT     CLRA
DD1D F6 A0 86                   LDAB BITNO
DD20 0D                         SEC
DD21 27 05              BITEST  BEQ  EXIT1
DD23 49                         ROLA
DD24 0C                         CLC
DD25 5A                         DECB
DD26 20 F9                      BRA  BITEST
DD28 B7 A0 86           EXIT1   STAA BITNO
                        *
                        *FALL THRU TO AD68
                        *DRIVER ROUTINE
                        *
DD2B 7F A0 85           AD68    CLR  INTRUP
DD2E 5F                         CLRB
DD2F 86 80                      LDAA #$80
DD31 B7 80 0C                   STAA PORT3
DD34 B6 80 0C           ENTER   LDAA PORT3
DD37 C1 FA                      CMPB #$FA
DD39 22 08                      BHI  EXIT
DD3B B5 A0 86                   BITA BITNO
DD3E 26 03                      BNE  EXIT
DD40 5C                         INCB
DD41 20 F1                      BRA  ENTER
DD43 F7 A0 87           EXIT    STAB DATA
DD46 86 40                      LDAA #$40
DD48 B7 80 0C                   STAA PORT3
DD4B B6 A0 85                   LDAA INTRUP
DD4E 26 DB                      BNE  AD68
DD50 39                         RTS
                        *
                        *
                                END
    SYMBOL TABLE:
AD68     DD2B          AD68C8   DD00
BIT      DD1C          BITEST   DD21
BITNO    A086          DATA     A087
ENTER    DD34          EXIT     DD43
EXIT1    DD28          INTRUP   A085
NEXT1    DD05          PORT3    800C
XTEMP    A018
```

*Listing 1.*

To help you use the AD-68 and driver routine above, the listing includes two other short routines. The first, BIT at $DD1C, converts a channel number (in hex) in BITNO to a bit number in BITNO for use by AD68, which is then executed. If you want to measure the voltage at the input channel number 4, simply place $04 into BITNO and execute BIT. It will change $04 to $08 and call AD68, leaving the digital measurement in DATA.

The other routine is an overall driver for the AD-68. It is called AD68C8, and is executed as a subroutine at $DD00. This routine will access all eight channels of the AD-68 and leave the digital data in eight bytes in ascending order of channel, starting at $A087. Nothing else need be done. The routine takes about 50 ms, and requires RAM from $A000 to $A08F. The whole procedure fits nicely into $50 hex bytes of EPROM, and, since the AD-68 is not based on a PIA, requires no setup routine.

Last, because timing and counting is done in software, the counting loop must not be interrupted. If your system *must* use interrupts, your interrupt service routine should set any bit of the data location INTRUP at $A085. The ADC service routine will then know that the count is invalid, and start it again. ■

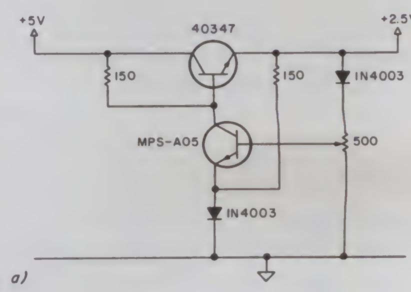



*Fig. 3a. Regulator.*

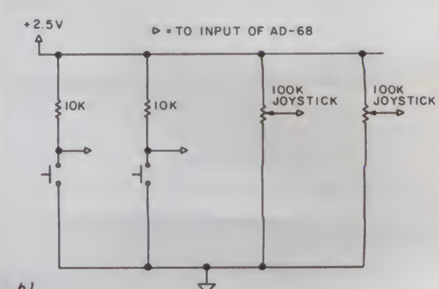
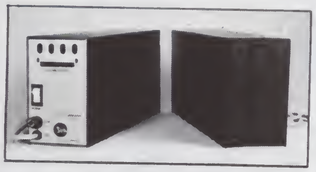



*Fig. 3b. Regulator connected to joysticks or push buttons.*

# SIRIUS 80+

## High Performance Low Cost Floppy Add-Ons!

The SIRIUS SYSTEMS 80+ Series of Floppy Disk add-ons are designed to provide unmatched versatility and performance for your TRS-80*. Consisting of four different add-ons, there is a 80+ Series Floppy Disk Drive to meet your needs.



**COMMON CHARACTERISTICS**

- *5ms track-to-track access time*
- *Auto-Eject*
- *180 day WARRANTY*
- *Exceptional speed stability - 11/2%*
- *Single/Double Density operation*
- *Mix any or all 80+ Series on the SS Standard cable*

**SPECIFIC CHARACTERISTICS**

The **SIRIUS 80+1** -a single sided, 40 track Drive. Offering 5 more tracks than the Radio Shack model, it cost $120 less. Formatted data storage is 102K/204K Bytes Single/Double Density.

**SIRIUS 80+1** ............... **$379.95**

The **SIRIUS 80+2** is a dual sided, 80 track (40 per side) Disk Drive. It appears to the TRS-80* as TWO 40 track drives yet **COST LESS THAN HALF THE PRICE!** Even greater savings result since data is recorded on both sides of the media instead of only a single side. This unit may require the SS Standard cable. Formatted data storage is 204K/408K Bytes Single/Double Density.

**SIRIUS 80+2** .............. **$449.95**

The **SIRIUS 80+3** - a single sided, 80 track Drive. Offering 2⅓ times the storage of a standard Radio Shack Disk Drive, the 80+3 greatly reduces the need for diskettes correspondingly. Additionally, because of the increased storage and faster track-to-track access time, the 80+3 allows tremendously increased throughput for disk based programs! The 80+3 includes SIRIUS's TRAKS-PATCH on diskette (for use with 96 tpi drives). Formatted data storage is 204K/408K Bytes Single/Double Density.

**SIRIUS 80+3** ............... **$499.95**

The **SIRIUS 80+4** -a dual sided, 160 track (80 per side) 5¼'' monster! The ultimate in state-of-the-art 5¼'' Floppy Disk Technology, the 80+4 is seen by the TRS-80* as two single sided disk drives. Thus, in terms of capacity, one 80+4 is equivalent to 4⅔ standard Radio Shack drives — at a savings of over 73% (not to mention diskettes!!!). (With a double density converter the available memory is huge!) The 80+4 (a 96 tpi drive) includes TRAKS-PATCH on diskette and may require the SS Standard cable. Formatted storage is 408K/816K Bytes Single/Double Density.

**SIRIUS 80+4** ............. **$649.95**

All 80+ Series Floppy Disk add-ons operate at 5ms track-to-track but are Expansion Interface limited to 12ms for the TRS-80*

**TRS-80© of Tandy Corp.*

**ACCESSORIES**

SS Standard 2 Drive Cable ......... **$29.95**

NEWDOS/80-Sophisticated Operating System for the TRS-80* from Apparat ..... **$149.95**

## Save up to 10% *with these SIRIUS Packages!*

NEWDOS/80, SIRIUS 80+3, and Two Drive Cable ............ **$624.95**

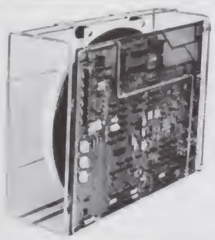
NEWDOS/80, SIRIUS 80+4, and Two Drive Cable ............ **$749.95**

NEWDOS/80, Two (2) SIRIUS 80+3's, Two Drive Cable ............ **$1080.95**

NEWDOS/80, Two (2) SIRIUS 80+4's, Two Drive Cable ............ **$1349.95**

# PRIAM

## Hard Disks Now Available from SIRIUS SYSTEMS!



PRIAM's high-performance, low-cost Winchester disc drives speed up throughput and expand data storage from 20 megabytes to 154 megabytes. And a single controller can be used to operate 14-inch-disc drives with capacities of 33, 66, or 154 megabytes or floppy-disc-size drives holding 20 and 34 megabytes. So it's easy to move up in capacity, or reduce package size, without changing important system elements or performance.

- *Fast, Linear Voice Coil Positioning*
- *10 ms track-to-track positioning*
- *Fully servoed head positioning*
- *Dedicated servo tracks*
- *DC Power required only!*
- *Simple, parallel Interface*
- *Optional SMD Interface*
- *50 ms Average Positioning time*
- *90 ms Maximum Positioning Time*
- *6.4 ms Average Latency*

### THE PRIAM LINEUP

| Model/Disc Size | Capacity | Size | Weight | Price |
|---|---|---|---|---|
| DISKOS 3350 (14'') | 33Mbytes | 7'' × 17'' × 20'' | 33 lbs. | $2995 |
| DISKOS 6650 (14'') | 66 Mbytes | 7'' × 17'' × 20'' | 33 lbs. | $3749 |
| DISKOS 15450 (14'') | 154 Mbytes | 7'' × 17'' × 20'' | 33 lbs. | $4695 |
| DISKOS 2050 ( 8'') | 20 Mbytes | 4.62'' × 8.55'' × 14.25'' | 20 lbs. | $2995 |
| DISKOS 3450 ( 8'') | 34 Mbytes | 4.62'' × 8.55'' × 14.25'' | 20 lbs. | $3745 |
| DISKOS 1070 | 10.6 Mbytes | floppy-size | (low) | $2195 |

All PRIAM DISKOS Drives have a Transfer Rate of 1.03 Mbytes/Sec.
*Optional SMD interface available for $150.*

SIRIUS SYTEMS offer cases and enclosures for all PRIAM Hard Disk Drives. All 14'' Winchester Drives will mount in our 14'' Standard Case. The 8'' Winchesters have two alternatives: a single drive case and a dual drive case. All SIRIUS SYSTEMS Winchester drive cases include Power Supply, internal cabling, switches, fan, extra AC outlet (not switched, but fused) and possess very adequate ventilation. Drive addressing is done on the rear of the Case and not on the drive iteself to provide ease of use during operation. All WINCHESTER DRIVE Cases are Warranted for a full year and come in our standard blue-black color scheme. Consult us for current availability and pricing.

# Introducing the Versatile, Low-Cost OMEGA Series Controller

As new technological advances bring down the cost of fast, reliable mass data storage, the need for an inexpensive, versatile controller have become greater and greater. To meet this need, SIRIUS SYSTEMS' OMEGA Series Controller was designed.

The SIRIUS OMEGA Series Controller Module utilizes an **on-board microprocessor** to mediate data transfer to a wide variety of peripherals from an equally wide variety of host computer systems. Up to four Winchester Hard Disks (8'' or 14''), four 5¼'' Floppy Disks Drives and/or up to eight 8'' Floppy Disk Drives may be **in use at one time.** Host systems interfacing is accomplished via a parallel or a serial interface. With the additon of a Personality module, the OMEGA Series Controller Module is directly **compatible with many popular computer systems** (among them the TRS-80*, Apple, Heath, and others). Provision is made for the addition of a streaming tape drive, also.

**SPECIFIC HARDWARE FEATURES INCLUDE:**

- *Control of up to twelve Floppy Disk Drives (eight 8'' and/or four 5¼'')*
  - *8'' and/or 5¼'' Disk Drive Utilization*
  - *Single (FM) or Double (MFM) density data storage*
  - *Hard or Soft sectored diskette usage*
  - *Utilization of "Quad" density (96 tpi) 8'' or 5¼'' Disk Drives*
- *Control of up to four WINCHESTER type PRIAM DISKOS Disk Drives*
  - *8'' or 14'' may intermix on the same cable*
  - *Accommodates 8'' and/or 14'' drives of 5.3Mbytes to 154Mbytes*
  - *Ultra-Fast data transfers*
- *Extremely flexible host-controller interfacing*

**SPECIFIC SOFTWARE FEATURES INCLUDE:**

- Dynamic format modifications via command words
- Extremely flexible format acceptance for unusual data storage formats
- Easily interfaces to standard operating systems (TRS-DOS*, CP/M®, etc)
- Operates in either get/put sector mode or data string mode
- Performance parameters may be changed by EPROM replacement or Dynaminic Reprogramming

*CP/M™ of Digital Research*

Dedicated systems cards are also available on a limited basis for the STD-BUS and the S 100. These cards feature shared memory also (again, software selectable) in addition to the regular OMEGA Series Controller Module features. Consult SIRIUS SYTEMS for current price and availability for the entire line of OMEGA Series Memory Units and Controllers. **Dealer inquiries are invited.**

# What TFORTH is - and what it has to offer YOU!

TFORTH is a unique growth programming language for the TRS-80® that combines the best features of an interpreter and a compiler all in one functional easy-to-use package. TFORTH cannot be simply compared with Fortran, BASIC or PASCAL. This high speed, high level modular code offers the speed found in many FORTRAN compliers yet retains the on-line conviences found in BASIC INTERPRETERS by flagging input errors as they occur line-by-line. Unlike PASCAL, TFORTH needs no "run-time" package for support. Serving as an operating system, compiler, assembler, interpreter, virtual memory manager, all in one: TFORTH makes easy, efficient- structured re-entrant programs a natural consequence.

The key to TFORTH's flexibility and ease of use lies in its use of a stack for parameters and a unique dictionary for WORDS. These WORDS are stated in terms of other WORDS already defined in the dictionary. It is this rich set of WORDS that provides DO LOOPS, IF-THEN-ELSE statements, BEGIN-END statements, virtual memory, any number base (to base 32) for input or output, a macro assembler, re-entrant code, multithread dictionary, line editor, excellent math package (16 bit integers, double precision floating point, SIN, COS, TAN, EXP and LOG) and it runs under either TRSDOS* or NEWDOS. Assembler inherently nests with high level in an easy fashion. Complicated drivers for new devices take only a few lines of TFORTH which saves both memory and disk space!

TFORTH is a procedural language specifing a process rather than a desired result. The ability to have the language grow in the direction the user desires is excellent for novel applications. New data types and new processes can become part of the language. Due to the modular constructions, a very compact code is produced which executes at exceptionally high speeds between machine code and machine code plus 20% typical overhead speeds. Memory requirements can be "less" than assembler coding or other high level languages.

TFORTH comes complete for the TRS-80® with as little as 16K of memory and a single Disk Drive using either TRS-DOS® or NEWDOS. It provided on diskettes and an optional Math and Utilities package is available.

Through TFORTH an excellent way to develop new languages, provide simple control of device (including video monitors, A/D and D/A converters and burglar alarms) and to implement tasks requiring monitoring and decision is offered. Many WORDS to handle peripherals are part of basic TFORTH and others may be added easily. Often, substantial hardware development can be eliminated by using TFORTH to do the major digital or reduction of data.

For many applications a minimal task may be written in high level (or mixture of assembler and high level) code: loaded, assembled and prior to execution may be written to the disk as a ready to execute machine code/EXE module with the DOS.

TFORTH (on diskette - specify for Standard or 96 tpi Disk Drives) ................. **$129.95**

TFORTH with the addition of TRAKS-PATCH (a powerful combination!) ............. **$136.95**

# STATE-OF-THE-ART DISK DRIVES

## QUME® DataTrak 8

### 8'' Disk Drive DOUBLE SIDED! DOUBLE DENSITY!

High performance Double Sided Disk 8'' Disk Drive ■ Single or Double Density ■ Door Lock and Write Protect INCLUDED! ■ Negative DC Voltage not required ■ Low Power Operation

- *FAST! 3ms track-to-track access*
- *Low friction and minimum wear*
- *Superior Head Load Dynamics*

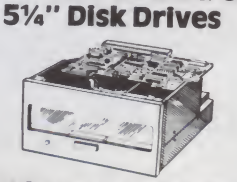
QUME DataTrak 8 ............. **$574.95** **(2/$549 ea)**

QUME Technical Manual .......... **$6.95**

Connector Set #3 (AC, DC, & Card Edge) ............................ **$10.95**

Connector Set #4 (AC and DC) ...... **$2.95**

## MPI 51/52 & 91/92 5¼'' Disk Drives



- *Fast! 5ms track-to-track access*
- *Exclusive Pulley-Band Design*
- *Unique Door/Ejector Mechanism*
- *Reliable 11/2% Speed Stability*
- *Single/Double Density Operation*
- *Industry/ANSI Standard Interface*

**MPI 51** (Single Head/40 tracks)
125K/250K Bytes Single/Double Density** ............ **$259.95**

**MPI52** (Dual Head/80 tracks (40/side))
250K/500K Bytes Single/Double Density** ............ **$349.95**

**MPI 91** (Single Head/80 tracks)
250K/500K Bytes Single/Double Density** ............ **$399.95**

**MPI 92** (Dual Head/160 tracks (80/side))
500K/1000K Bytes Single/Double Density** ............ **$524.95**

MPI Technical Manual ........ **$6.95**

**Unformatted data storage

## *TO ORDER CALL (615) 693-6583*

Phone Orders Accepted 9AM-7PM (EST) Mon-Fri

We accept **MC, VISA, AE, COD** (requires Certified Check, Cashier's Check or Cash) and **Checks** (personal checks require 14 days to clear). **SHIPPING AND HANDLING:** $7.00 per Floppy Disk Drive or 80+ Module ■ 5% for other items (any excess will be refunded) ■ **Foreign Orders** add 10% for Shipping & Handling. Payment in U.S. currency ■ Tennessee residents add 6% Sales Tax ■ **VOLUME DISCOUNTS AVAILABLE**

↙67

SIRIUS SYSTEMS
7528 Oak Ridge Highway
Knoxville, Tennessee 37921

# Exploring The Source

*A walk through the world of electronic communications.*

*Sherman P. Wantz*
*424 NW Lakeview Drive*
*Sebring, FL 33870*

I often try to disguise my true interest in computers by pointing to their many practical applications. But when someone pins me down, I have to admit that I've put very few of them to use.

I can't explain why I am defensive on the subject. Perhaps it's because I don't expect others to understand that I respond to my computer for the reason that it represents a challenge. I'm driven to master it!

My computer creates in me a pioneer spirit analogous to the fervor that motivated our forefathers to explore and settle the West.

The thought that I am on—or, at least, near—the frontier of technology is a heady experience. To a great extent, that feeling explains why I am fascinated by The Source, a relatively new electronic communications facility.

When I began reading Frank J. Derfler, Jr.'s series of "Dial-up Directory" articles in *Microcomputing*, my eyes were opened to a challenging use for my computer. I learned that I could couple the input and output of my equipment into a telephone line and communicate with other computers. Another opportunity to explore the unknown!

*Photo 1. The CT-82 "smart" terminal works with almost any modem or computer system. It uses a Motorola 6802 microprocessor and 6845 CRT controller to provide over 100 control functions.*

Then I learned that I could use my own computer in Sebring, FL, to gain access to data being stored in banks of computers located near the nation's capital.

This included state, national and international news stories filed by United Press International and *The New York Times*; hourly stock exchange reports; airline schedules; travel information; business and game programs; and electronic mail services.

The research prospects alone boggled my imagination. A new and exciting world was waiting to be explored.

I couldn't wait to sign up.

### Arranging Passage—Not Easy

My initial move was to write for details to Source Telecomputing Corp. (formerly known as Telecomputing Corp. of America), 1616 Anderson Road, McLean, VA 22102.

Before the requested literature had arrived, I made a trip to Towson, MD, where I visited two computer stores. I didn't know that both store owners were authorized to sell subscriptions, as well as equipment needed to use The Source.

At the first store, my questions about The Source were almost totally ignored. The clerk was too busy trying to operate a computer to give me much attention. He handed me a brochure entitled "A Brief Guide to Network Information Resources," published by The Source, and returned to his computer.

The salesman at the second store was a bit more helpful. He gave me a four-page flier entitled "The Source, the World's First Information Utility," and let me look through his copy of the instruction manual that The Source provides to its subscribers.

At neither store was I offered a subscription application form. However, I found an

application blank in a copy of *Sourceworld*, The Source's slick monthly magazine, which I bought for $2.

No offer was made at either store to demonstrate The Source. Later, when I learned that Source computer access time during business hours cost $15 per hour, I could understand why such demonstrations might be hard to justify.

One bit of invaluable information I obtained from the four-page handout was The Source's toll-free customer service number (1-800-336-3330), which prospective subscribers are invited to call.

**Making Contact**

One disturbing fact that I discovered from The Source's user's manual was that my city did not have a local telephone number to gain access to The Source's computers. Only those who live in cities with populations of 50,000 or more are provided with local telephone numbers, unless *special arrangements had* been made.

Did that mean that I would have to place a toll call each time I wanted to use The Source's computers?

My call to Telenet's customer service office disclosed the fact that a toll-free telephone number could be made available to me and other small city or rural subscribers —at the rate of $15 per hour. (Telenet is one of the companies—the other is Tymnet—that furnishes computer network services to users of The Source.)

Again, I called The Source representative, who confirmed the information that Telenet had given me. No toll-free number was available for use by subscribers living in rural America.

I called the Bell System office in Kansas City, MO, and asked about using their $18-a-month call forwarding (RCF) service they've been advertising lately. The Bell System representative said he didn't think letting me call The Source in Virginia was what his company had in mind when they instituted RCF.

My call to the special communications office of Florida's United Telephone System proved to be equally discouraging. Their solution: lease a dedicated line to Tampa, a city served by Telenet and Tymnet, at the cost of a mere $305 per month. I declined that offer.

A close examination of long-distance telephone rates showed that I could make a direct-dial toll call to Orlando, FL (a distance of about 70 miles), at night (11 PM to 8 AM) and during weekends for $9.61 per hour. It was high but, if used with discretion, not intolerable.

But I was in for another surprise. I discovered that I could make a direct-dial call during the same time periods to Atlanta, GA (a distance of 500 miles) for $8.46 per hour, $1.15 per hour cheaper than I could make a call to nearby Orlando. A lesson in economics: a monopoly by any other name is a monopoly still.

So, accepting the fact that I would have to pay $8.46 per hour for nighttime or weekend use of the telephone connection plus $4.25 per hour ($2.75 per hour after midnight local time) for nonprime time use of The Source's computers, I decided to complete the application form and mail it to McLean, VA.

**Charge—Not Just for Cavalry**

Those who subscribe to The Source must possess a valid Visa, Master Card or American Express credit card. Literature distributed by The Source hints that only corporations using the services can be approved for direct billing.

When I subscribed, I was granted the option of paying my $100 registration fee either by personal check or by credit card. After that, The Source wasn't interested in my personal checks, preferring to deal directly with Citibank, the New York financial institution that issued my Visa credit card.

By signing The Source's application form, I agreed that the monthly service charge ($10 minimum) could be assessed against my Visa account.

I was surprised at my reaction to STC's requiring their subscribers to pay for services rendered via credit card. While I sympathize with those who might not have one of the three prescribed credit cards—probably not many computer owners among them—I found myself applauding STC for its business acumen. By billing its subscribers' credit accounts directly, STC's overhead expenses for collecting delinquent service charges must be low.

**Reading the Map**

Within three weeks of the date I mailed my application form to STC, I received my Source user's manual.

Written on page two of the manual was my Source account number, referred to as my identification (ID) number, and my password—four letters seemingly selected from the alphabet at random.

The identification number assigned to my account was TCH532. The user's manual informed me that my account number would have to be used each time I signed on for me to gain access to The Source.

The manual also explained that in addition to checking my account number, The Source's computers would also check my password. Since my account ID number might be widely disseminated—as it is now to readers of this article—the use of a password, too, would constitute a degree of insurance against unauthorized use of my account.

From the manual, I learned that I needed a home address to let me instruct the Telenet and Tymnet control computers to connect me to The Source. Those networks serve other data banks, commercial service

Read about the sale of The Source to *Reader's Digest* in this issue's Micro-Scope section, p. 13.

*Photo 2. The CAT acoustic modem allows switch-selectable originate or answer option as well as full- or half-duplex operation.*

bureaus, educational institutions and companies and must be told by a home address which service you are calling.

Unfortunately, my manual did not provide the required home address. I learned just how important this omission really was after I was rejected three times by Telenet. It hurts to be rejected—even by a switching network computer. A call to my favorite toll-free number in McLean, VA, resulted in my obtaining the required home address. More about that later.

Two lists of telephone numbers were provided in a pocket attached to the rear cover of my user's manual. Each list contained local telephone numbers in about 250 U.S. cities that users of the Telenet and Tymnet networks could call to access (gain entrance to) The Source. From the Telenet list I chose the number in Atlanta.

One important document that accompanied my manual was an agreement entitled "Terms and Conditions." Obviously written by attorneys, the agreement defined terms such as "connect time" and "disk storage," set forth STC's billing procedures, provided for future Source rate changes (already exercised), explained subscription cancellation and termination conditions and claimed liability and indemnity limits for STC.

**I learned that I didn't really need a complete computer to be able to access The Source. A so-called "smart" terminal would do.**

### Preparing for the Expedition

From ads and articles that had appeared in various computer magazines, I learned that I didn't really need a complete computer to be able to access The Source. A so-called "smart" terminal would do.

I just happened to have a smart terminal —a CT-82 (see Photo 1) manufactured by the Southwest Technical Products Corp., San Antonio, TX. Since the CT-82 contains its own microprocessor to provide cursor control, character formatting, editing and so on, I decided to use it in lieu of buying one of the "black boxes"—with associated software—that were being offered to convert my TRS-80, Model I, into a smart terminal.

With the terminal requirement already satisfied, I turned my attention toward deciding which type of modem I would need.

To digress for a moment or two, let me explain that the word modem is a contraction of the words modulate and demodulate.

A modem is a device that makes it possible to send signals produced by a computer many thousands of miles over regular telephone lines. It does this by converting (modulating) direct-current data pulses produced by the sending computer into audio tones that are then transmitted over the telephone network.

At the receiving end of the line, the tone signals are converted (demodulated) into direct-current data pulses and are fed into the local computer or terminal.

Two major types are readily available for use in telephone communication: the acoustic modem and the direct-connection modem.

An acoustic modem requires no physical connection to telephone lines. It obtains its tone signals from and delivers its tone signals to a telephone handset via its built-in microphone (for receiving tones) and speaker (for sending tones). The telephone handset's mouthpiece and earpiece are placed into the modem's foam muffs (cushions).

A direct-connection modem is usually more efficient than the acoustic type but is often more expensive to buy. The direct-connection modem feeds its tones directly into the telephone line rather than passing its tones through ear and mouthpieces of a handset. Background noises such as TV sounds, voices, printer chatter and cooling fan hum, picked up by an acoustic modem, are eliminated.

The direct-connection modem could be more costly to install than the acoustic type. Since a connection must be made to the telephone lines, plugs and adapters may be required to effect the proper hookup.

If my telephone instrument had been a Princess style or one of GTE's new "flip" models, neither of which would readily fit into the muffs of an acoustic modem, I might have been forced to consider using a direct-connection modem. The alternative would have been to buy a standard handset telephone.

Since my telephone instrument was of the regular, old-fashioned variety, I decided to take the least expensive approach. I bought a CAT acoustic modem (see Photo 2) manufactured by Novation, Inc., Tarzana, CA.

The compact, 1½ pound CAT modem is self-powered (plug-in power pack), lets me originate calls to other computers or answer calls originated by others, operates at the proper rate (300 bits per second) required by The Source, permits full- or half-duplex operation (more about that later) and contains a useful self-test feature.

To complete my installation, I found that I needed two cables. One was a four-conductor, 15-foot long telephone extension line that would let me move my telephone instrument from my desk to a position next to my modem. That cable was easily purchased from my local Radio Shack store.

The other cable connected my CT-82 terminal to the CAT modem. James Electronics of Belmont, CA, supplied a customized six-foot long ribbon cable, terminated at both ends with DB-25 connectors.

I soon learned that "DB-25" and "RS-232C" were terms that telecommunicators use with unrestrained frequency.

In my case, the DB-25 plug and receptacle were 25-pin connectors used to link the CAT's RS-232C interface board with a similar board that was mounted in my CT-82 terminal.

RS-232C is the number assigned to a data voltage specification that has been accepted by the Electronics Industries Association as its standard.

After I had connected modem to terminal, I placed my telephone handset into the modem's muffs, applied power, set one modem switch to "originate" and the other switch to "test." Then, I dialed a number on my telephone (to get rid of the dial tone) and, using my terminal's keyboard, typed several words that appeared on the terminal's video monitor screen, indicating that the modem was working properly.

I was now fully prepared to begin life on one of technology's new frontiers—or so I thought.

### Hardships Multiply

My first three attempts to access The Source were abysmal failures.

After I had activated my terminal and modem, I dialed Telenet's phone number in Atlanta. As soon as I heard a tone in my telephone earpiece, I placed the handset into my modem's muffs and noted that the modem's "Ready" light-emitting diode indicator came on. So far, so good.

As directed by my user's manual, I pressed the terminal's return key twice and watched as Telenet's name flashed on my screen.

After I had obtained Telenet's prompt ("@"), I typed "C 301##" as my home address identifier—exactly as my manual instructed me to do. Three times, Telenet

✓Reader Service—see page 257

rejected my call and then terminated my connection.

As I recounted earlier in this saga, I called The Source for help. Valiantly suppressing his urge to laugh, the customer service representative explained that instead of typing "C301##," I should have typed "C 301," followed by two numbers provided on page two of my manual opposite "home address." The two pound signs used in the manual's sign-on example were not meant to be taken literally, he explained.

When I informed him that his McLean, VA, office from whom I had purchased my subscription had not provided me with the missing "home address" digits, the customer serviceman quickly did so.

My next call made to the Atlanta Telenet number—this time using the correct "home address"—produced another problem.

In response to The Source's invitation to "Please sign on," I typed "ID TCH532," followed by my four-character password, which I typed, as instructed, while I depressed my terminal's control (CTRL) key.

Each attempt to sign-on was rebuffed by The Source with an "illegal password" message. Eventually, after allowing me three unsuccessful attempts to get it right, The Source terminated my connection.

Again, I phoned The Source. By now, I had established a first-name relationship with The Source's duty technician. When I explained my current problem, The Source's expert told me that one of the control characters in my password (CTRL U) was causing the problem. Fortunately, my new-found friend had access to the password files and was able to provide me with a new password that worked.

On my fifth attempt, I finally made it into the inner sanctum of The Source.

But my problems persisted. Every character that I typed using my CT-82 terminal's keyboard appeared twice on my video screen. However, the characters sent to me by The Source appeared singly. Strange.

Another call to The Source clarified that phenomenon. My terminal and modem were configured for half-duplex operation, and The Source was operating at full-duplex. The first of the pair of duplicate characters that appeared on my monitor's screen was being placed there by circuitry within my terminal; the second character that appeared beside the first was being echoed by The Source.

According to my buddy at The Source, I could do one of two things to solve my duplicate character problem. I could either reconfigure my terminal and modem for full-duplex operation (preferred) or I could type "TTEERRMM HHAALLFF" whenever I signed on. The latter message would inform The Source's computer that my terminal and modem were operating half-duplex and would result in the distant computer suppressing its character echo.

Later, I learned that I could achieve the same echo-suppression result by sandwiching a semicolon between the two carriage returns (CR ; CR) I have to send when I initiate my call to Telenet.

### Exploring the Territory

The 75-page user's manual devotes most of its space to instructing subscribers in the proper use of commands needed to get the most from The Source.

I followed the manual's instructions, step-by-step, to review The Source's library by typing "DATA LIBALL," pressed the control key as I typed the letter "S" (CTRL S) to "freeze" the listing on my video monitor's screen, used CTRL Q to restart the display and pressed the break key or CTRL P to escape from the library listing.

Again, following the manual's instructions, I played a few hands of blackjack (PLAY BLACKJACK), reviewed a list of topics covered by *The New York Times* Consumer Data Base (NYTCDB), obtained the latest information on the Baltimore Colts football team (UPI S MD S TRADE AND COLTS) and reviewed the current situation in Iran (UPI N G IRAN).

I experienced some difficulty trying to interrupt the flow of information from The Source, particularly while I was accessing the UPI data bank. I followed the manual's instructions by pressing the terminal's break key, typing CTRL P, typing STOP and QUIT, any one of which should have allowed me to escape the current program and obtain The Source's right arrow prompt. Nothing seemed to work.

After wasting about 15 minutes trying to regain control, I solved the problem by pressing the break key and holding it down for several seconds. Merely engaging the break key momentarily, as I would any other keyboard key, did not get The Source computer's attention.

The feature I liked best about The Source was its electronic mail service. I used the MAIL command to send messages to *Microcomputing*, to The Source customer service office (TCA088) and to other subscribers who have listed their names, account numbers and interests in The Source's directory.

The first thing I do after I sign on is to inquire whether or not The Source has any messages addressed to my account. I do this by typing "MAILCK." If there are no messages, The Source reports: "No mail at this time." However, if there are several messages awaiting me, The Source reports their number (MAIL (3)), then allows me to review each message by subject matter or

by sender account number (SCAN) or to read the messages consecutively (READ).

After I read each message, The Source gives me the option of 1) replying immediately, 2) saving the message for later disposition or 3) deleting it. Since I do not yet have a printer connected to my terminal to provide a permanent record of my incoming electronic mail, I have had to learn to exercise restraint in ordering the deletion of messages. Once a message has been deleted, there is no way for a subscriber to retrieve it.

Perhaps the most clearly hobby-related feature of The Source's services is designated CHAT.

CHAT permits exactly what its name implies—an unstructured conversation with another Source subscriber. The result is quite similar to the activity that amateur radio hams refer to as a QSO—a freewheeling ragchew.

Any time I am connected to The Source, I merely type "ONLINE" to obtain a listing of the account numbers of subscribers who are currently using The Source.

To initiate my first CHAT contact, I typed "CHAT" followed by the account number of an individual I had determined to be connected to The Source at that time. The person that I had called terminated The Source program he had been using and responded to my call. We exchanged views about—what else?—The Source.

Because others might have to pay long-distance phone rates plus computer access time too, I do not initiate CHAT calls unless I have previously arranged for the call using the electronic mail service.

Of course, I answer any calls that are made to me by other subscribers. I usually ask a caller for his telephone number, call him directly and chat verbally rather than CHAT via terminal keyboards using slow, hunt-and-peck typing.

Any time I use The Source for serious research purposes, I type "REFUSE CHAT" when I sign on. That prevents anyone from interrupting my research activity. It also avoids offending a subscriber that might call me and not receive a response.

Another service of The Source that I find fascinating is entitled "Classified Ads & Bulletin Board." It is accessed by typing "DATA CLASSI." Subscribers are permitted to use this service for general announcements or to list objects for sale or services for hire.

I had no difficulty learning how The Source expected me to terminate my connection. All I had to do was to type "OFF" after I obtained the right-arrow prompt indicator. As its parting message, The Source calculates and reports to me the number of minutes I have been connected.

**Adventure Calls**

If I were to remain connected to The Source around the clock for a year, I doubt that I'd be able to tap all of the information that is now available there.

Over 600 topics are listed in The Source's master index, and the list is growing. The data bank is practically inexhaustible.

How can you subscribe? If my experience is any criterion, you must be persistent. First, recognize that there are over 200 computer stores located in about 40 states that can process subscriber applications and can sell or lease equipment needed to use The Source. Second, place a call to The Source (1-800-336-3330) to obtain the name and address of a dealer in your vicinity. Third, visit your dealer and ask for an application form. Complete the form, attach your registration fee and get your account number.

The Source is compatible with almost all computers and terminals. Several companies are now making equipment in the $250 to $300 price range that allows the TRS-80, Model I, computer to become a "smart" terminal fully capable of communicating with The Source.

There are other telecommunication networks in operation throughout the country. Some of them have been established primarily to serve the interests of hobbyists. One such network with which I am familiar is Forum-80, whose headquarters is located in Kansas City, MO. Others are known simply as computer bulletin boards. Almost all are available to anyone who has the basic equipment described in this article.

Telecommunication has added a new dimension to computing. In addition to the pleasure that has come from demonstrating to others that my computer can "do something useful," networking has placed a wide range of state, national and international information quite literally at my fingertips.

To learn more about this challenging field, I urge you to refer to previous issues of *Microcomputing*, beginning in January 1980, and read Frank Derfler's series of articles entitled "Dial-up Directory."

If you would like to join me on the frontier of computer applications technology, get a modem and upgrade your computer to accommodate networking.

If you decide to subscribe to The Source, please send me an electronic mail message at TCH532 to give me your reaction to telecommunicating.

Before you decide to move to the data retrieval frontier, represented by The Source, check to be certain that you have a valid credit card.

You *can't* leave home without it! ■





✓ Reader Service—see page 257

# The Master Catalog System For CP/M Users

*A software superbargain for logging your disks.*

*Rod Hallen*
*State Department—Accra*
*Washington, DC 20520*

Computerists who move up from tape to disk find a whole new world to work with. The quick and easy program storage and retrieval certainly makes life simpler.

However, one function actually becomes more difficult—keeping track of programs. They are so easy to load or move from disk to disk that it is often a long, tedious job finding what you are looking for.

I have 54 eight-inch disks. Some are single-density, but I've been buying double-density since I got my ThinkerToys Discus 2D Disk Operating System. Some of these disks are also double-sided, which means that each disk can store as many as one million bytes of data.

In my early days, I numbered each tape or disk and kept a hand-written log of its contents. As I accumulated more disks, this got completely out of hand. Popping disks in and out of the drives to read the directories is time-consuming when you are looking for something. I even occasionally tried dumping a hard copy of each disk directory, but these quickly became obsolete.

But I've found a solution—the Master Catalog System. Available on a single-density eight-inch CP/M formatted diskette from E. A. Elliam Associates (5658 Keokuk Ave., Woodland Hills, CA 91364) for $10, this has got to be some kind of software superbargain.

### The System

The Master Catalog System is semi-automatic; you have to remind it every once in a while to create a new up-to-date catalog for you. I now have 1107 entries in mine. Trying to keep track of that many programs by hand would be impossible.

The system diskette contains 18 programs, which include both the source and object codes (see Table 1). I'm happiest when I can get my hands on the source, since I invariably want to make changes to suit my needs.

Besides the software to make the Master Catalog work, three programs list disk directories alphabetically, with program size in K, and total vacant space available on the disk. These listings are three or four columns wide, depending upon the width of your screen. This is much better than the "scroll off the screen" mode of the standard CP/M DIR listing.

The system comprises a series of programs used to create and display the catalog. If you have a printer, you can also dump a hard copy. It is easiest to maintain a catalog if you have at least two drives, but it can be done with one.

The first step is to identify each disk. I set up the numbering system shown in Table 2. This lets me select disks by number or colored tab. I buy the disks numbered S-1 to S-35 (GREEN) commercially; after their contents have been copied to a working disk I store them for backup and don't use them in day-to-day operations. I know that all disks in the 100 series (RED) are assembly-language programs in either source or object code, that all of the disks numbered in the 200s (GRAY) contain BASIC programs and so on.

After I number each disk, I record it in that disk's directory. Thus, the Master Catalog System knows which disk it is looking at when it creates or updates a catalog entry.

I use the CP/M editor (ED.COM) to place the disk identity into the directory thus:

1. With a disk in drive A that contains ED.COM, I place the disk to be numbered in drive B.

2. The CP/M command ED B:—DISK.100 opens a file —DISK.100 on the disk in drive B.

3. The ED command Q closes this open file without any text being entered into it.

4. The result is a directory listing —DISK .100, which has no actual file associated with it. The — is used at the beginning of each identification entry, because this will place it first alphabetically in the disk directory and because this is what the Master Catalog System is looking for.

The Master Catalog System uses five or six programs included on this disk. Both source (ASM LIB) and object (COM) programs are included.

| Program Name | Description |
|---|---|
| CAT | Master Catalog Program |
| CATL | Sorted Catalog 'DIR' |
| CATF | Reads Disk Directory |
| CATQ | Single Disk 'CATF' |
| CATS | Sorts Disk Directory |
| CATU | Updates Master Catalog |
| MACRO.LIB | Req'd to ASM CATL |
| SEQIO.LIB | Req'd to ASM CATQ CATU |

*Table 1. The Master Catalog System.*

| Type of software | Disk identification number and color |
|---|---|
| Commercial programs | -DISK.S-1, -DISK.S-2,... Green |
| Assembly language | -DISK.100, -DISK.101,... Red |
| BASIC programs | -DISK.200, -DISK.201,... Gray |
| Word processing | -DISK.300, -DISK.301,... Yellow |
| Pascal programs | -DISK.400, -DISK.401,... Blue |
| Working disks | -DISK.500, -DISK.501,... Pink |

*Table 2. Numbering system.*

I did this with every disk in my library. Double-sided disks have consecutive numbers for each side. A numbering system of your own design could quite easily be substituted for mine. You might call your BASIC disks —BASIC.001, —BASIC.002 and so on; your assembly-language disks —ALP.001, —ALP.002, etc., and your word processor disks —WORD.001, WORD.002, etc.

**Creating the Catalog**

The next step is to create the actual catalog that will be stored on disk as MAST.CAT. One of the features of MAST. CAT is that you can tell it what you don't want it to list. For instance, if you have ED.COM, DDT.COM and other utility programs scattered throughout your library, you can enter them using ED.COM at the beginning of MAST.CAT and they will be ignored in subsequent catalog operations. This cuts down on the size of the catalog and increases its operating speed.

A disk containing the Master Catalog System is now placed in drive A, and the disk to be cataloged is placed in drive B. The command CATF B: F will create a temporary file called NAMES.SUB, which contains the names of all of the files on the disk in drive B in alphabetical order. The command CATU will read MAST.CAT and add or remove any entries that have changed since the last time this particular disk was cataloged. If this is the first time that this disk has been cataloged, then everything in its directory will be entered into MAST.CAT. At the end of this operation the screen displays a list of added and deleted programs, as well as the total number of programs in MAST.CAT.

You can expect this quick and painless operation for each disk in your collection. It is a little more difficult if you only have one drive, since you must keep swapping between the disk containing MAST.CAT and the disk being cataloged, but the results are the same.

When the catalog becomes as large as mine (over a thousand entries), it takes a while for CATU to read and modify it, but we're still only talking about 15 or 20 seconds per disk.

You can catalog a disk to reflect changes as often as you like. Each time that MAST. CAT is updated, the previous version is renamed MAST.BAK; thus, you always have a backup copy in case a power problem or computer glitch destroys the new one. In addition, I always use PIP to copy MAST. CAT onto a second disk in case the first disk should be destroyed or made unreadable.

Once you have MAST.CAT up to date, what can you do with it? The command CAT will display the entire catalog in alpha-

```
A>CAT
            ROD HALLEN MASTER DISK CATALOG
FILES:

  NAME             DISK              NAME             DISK

24CPM    .COM    DISK     .211    2DM      .        DISK     .302
2DM      .TXT    DISK     .300    88-MODEM.ASM      DISK     .S25
88-MODEM.DOC     DISK     .S25    ADD      .ASM     DISK     .S29
ADD      .MAC    DISK     .S29    ADD      .Z80     DISK     .S29
ADD1     .ASM    DISK     .S29    ADD2     .ASM     DISK     .S29
ADD3     .ASM    DISK     .S29    ADE      .ASM     DISK     .S27
AIRMAILE.PCL     DISK     .100    ALLOC    .COM     DISK     .S26
APOLLO   .BAS    DISK     .202    ASCCR    .FAS     DISK     .S12
ASCHX    .FAS    DISK     .S12    ASCII    .FAS     DISK     .S12
ASM      .COM    DISK     .102    ASM      .COM     DISK     .201
ASM      .COM    DISK     .203    ASM      .COM     DISK     .211
ASM      .COM    DISK     .313    ASM      .COM     DISK     .500
ASM      .COM    DISK     .501    ASM      .COM     DISK     .S-7
ASM      .COM    DISK     .S10    ASMB     .COM     DISK     .102
ASMB     .COM    DISK     .S-8    ASMB     .HEX     DISK     .S-8
ASMB     .REL    DISK     .S-8    ASMBM    .PCL     DISK     .100
ASMX     .COM    DISK     .S16    ASSIGN   .ASM     DISK     .S15
ASSM     .COM    DISK     .102    ASSMM    .PCL     DISK     .100
AUTO     .COM    DISK     .201    AX10     .FAS     DISK     .S12
B        .       DISK     .302    B6800M   .PCL     DISK     .310
BANNER   .ASM    DISK     .S26    BANNER   .BAS     DISK     .202
BASEX    .COM    DISK     .S35    BINH     .FAS     DISK     .S12
BINLOAD1.ASM     DISK     .S26    BIO      .BAS     DISK     .202
BIOS     .ASM    DISK     .313    BIOS     .FAS     DISK     .S12
BIOSGO   .LIB    DISK     .S26    BKSPACE  .DOC     DISK     .S25
BLENG    .FAS    DISK     .S12    BLKFRID  .BAS     DISK     .202
BLKFRID  .PCL    DISK     .202    BLKFRIL  .BAS     DISK     .202
BLKJK    .BAS    DISK     .202    BMOVE    .FAS     DISK     .S12
BMULT    .FAS    DISK     .S12    BOOT     .ASM     DISK     .S17
BOOT     .ASM    DISK     .S25    BOOT     .DOC     DISK     .S25
BOOTER   .DOC    DISK     .S17    BPNF     .ASM     DISK     .S26
BSM      .PCL    DISK     .310    BSPAT16B.ASM      DISK     .S26
BUS1     .       DISK     .S34    BUS2     .        DISK     .S34
BUS3     .       DISK     .S34    BUTTONS  .LIB     DISK     .S-5
BYTEAD   .PCL    DISK     .S32    BYTEMOV  .ASM     DISK     .S26
C-VERT   .COM    DISK     .S32    CASDSK   .ASM     DISK     .S15
CAT      .ASM    DISK     .S-9    CAT      .ASM     DISK     .S25
CAT      .COM    DISK     .103    CAT      .COM     DISK     .S-9
CATALOG  .1      DISK     .S15    CATALOG  .16      DISK     .S16
CATALOG  .19     DISK     .S27    CATALOG  .24      DISK     .S24
CATALOG  .25     DISK     .S25    CATALOG  .31      DISK     .S13
CATALOG  .32     DISK     .S14    CATALOG  .8       DISK     .S26
CATALOG  .DOC    DISK     .S25    CATD     .ASM     DISK     .S-9
CATD     .COM    DISK     .S-9    CATF     .ASM     DISK     .S-9
CATF     .COM    DISK     .S-9    CATL     .ASM     DISK     .S-9
```

*Sample 1. The first page of my MAST. CAT file. Note that the programs are listed in alphabetical order with the disk identification number following each one and that the listing is paged and numbered. I modified CAT a little to include my name at the top. The command "CAT" initiated this printout.*

```
A>CAT *.* *.S-7
            ROD HALLEN MASTER DISK CATALOG
FILES: *.* *.S-7

  NAME             DISK              NAME             DISK

ASM      .COM    DISK     .S-7    COPY     .COM     DISK     .S-7
CPM24    .COM    DISK     .S-7    DDT      .COM     DISK     .S-7
DENSITY  .ASM    DISK     .S-7    DENSITY  .COM     DISK     .S-7
DUMP     .ASM    DISK     .S-7    DUMP     .COM     DISK     .S-7
EBASIC   .COM    DISK     .S-7    ED       .COM     DISK     .S-7
FORMAT   .ASM    DISK     .S-7    FORMAT   .COM     DISK     .S-7
HEART    .ASM    DISK     .S-7    LIST     .COM     DISK     .S-7
LOAD     .COM    DISK     .S-7    MOVCPM   .COM     DISK     .S-7
PIP      .COM    DISK     .S-7    REGEN    .ASM     DISK     .S-7
REGEN    .COM    DISK     .S-7    RUN      .COM     DISK     .S-7
SAVEUSER.COM     DISK     .S-7    SINGLE   .ASM     DISK     .S-7
SINGLE   .COM    DISK     .S-7    STAT     .COM     DISK     .S-7
SUBMIT   .COM    DISK     .S-7    SYSGEN   .COM     DISK     .S-7
TTUSER   .ASM    DISK     .S-7    TTUSER   .PCL     DISK     .S-7
TTUSERZ  .ASM    DISK     .S-7    TTUSERZ  .HEX     DISK     .S-7
TTUSERZ  .PRN    DISK     .S-7    USER     .ASM     DISK     .S-7
```

*Sample 2. A printout of all of the programs on a particular disk. In this case, S-7. "CAT *.* *.S-7 means to list every program (*.*) on disk S-7.*

betical order, two columns wide, with the disk identifying number next to each entry (Sample 1). You can also call for the contents of a particular disk (Sample 2) or for a certain type of program (Sample 3). The ??? and * entries used in other CP/M commands also function in CAT, giving you a wide choice of listings.

The CAT listings are paged and numbered so that the CP/M control-P printer toggle allows you to print hard copy of your catalog. I do this about once a month to keep mine fairly current. When I am looking for a specific program I can look in the latest copy of my catalog, or I can query CAT for its location. CAT even has a provision that lets you have the current date printed at the top of the hard copy.

### One Complaint

If I have any complaints with this package, it has to do with the alphabetical directory display listing programs that come with it. The ThinkerToys Discus 2D Disk Operating System lets me use single- or double-density disks interchangeably, but the directory programs will not work with double-density disks. This is because they read the directory by sector, instead of using the CP/M Disk Read primitive. The sequence of sectors is different for single- and double-density disks. Since Elliam supplies the source code, I'll have to sit down one of these days and do a little rewriting.

Another program included in the package is CATS, which reads a disk directory, sorts it in alphabetical order and puts it back on the disk. This is another one that works well with single-density but not double-density disks, and probably for the same reason.

Neither of these faults affects the Master Catalog System that works with all of my disks. The price is definitely a bargain; I would gladly have paid $50! ■

```
A>CAT *.ASM
                  ROD HALLEN MASTER DISK CATALOG
FILES: *.ASM

  NAME          DISK                NAME          DISK

88-MODEM.ASM   DISK      .S25     ADD     .ASM   DISK      .S29
ADD1    .ASM   DISK      .S29     ADD2    .ASM   DISK      .S29
ADD3    .ASM   DISK      .S29     ADE     .ASM   DISK      .S27
ASSIGN  .ASM   DISK      .S15     BANNER  .ASM   DISK      .S26
BINLOAD1.ASM   DISK      .S26     BIOS    .ASM   DISK      .313
BOOT    .ASM   DISK      .S17     BOOT    .ASM   DISK      .S25
BPNF    .ASM   DISK      .S26     BSPAT16B.ASM   DISK      .S26
BYTEMOV .ASM   DISK      .S26     CASDSK  .ASM   DISK      .S15
CAT     .ASM   DISK      .S-9     CAT     .ASM   DISK      .S25
CATD    .ASM   DISK      .S-9     CATF    .ASM   DISK      .S-9
CATL    .ASM   DISK      .S-9     CATLZ   .ASM   DISK      .201
CATLZ   .ASM   DISK      .302     CATQ    .ASM   DISK      .S-9
CATS    .ASM   DISK      .S-9     CATU    .ASM   DISK      .S-9
CATZ    .ASM   DISK      .201     CATZ    .ASM   DISK      .302
CBIOS24 .ASM   DISK      .S25     CONSTRL .ASM   DISK      .S-6
CONSTRZ .ASM   DISK      .302     COPY    .ASM   DISK      .S15
COPY    .ASM   DISK      .S25     COPY    .ASM   DISK      .S27
COPYDSK .ASM   DISK      .S16     COPYX   .ASM   DISK      .S15
CPMUTIL .ASM   DISK      .S16     DCHAYES .ASM   DISK      .S25
DCHDIAG .ASM   DISK      .S25     DDTPATCH.ASM   DISK      .S26
DENSITY .ASM   DISK      .203     DENSITY .ASM   DISK      .S-7
DIABLO  .ASM   DISK      .S15     DISASSM1.ASM   DISK      .S15
DISASSM2.ASM   DISK      .S15     DISKDUP .ASM   DISK      .S26
DISKTES1.ASM   DISK      .S26     DISKTEST.ASM   DISK      .S15
DSKCAS  .ASM   DISK      .S15     DSKDIR  .ASM   DISK      .S26
DUMP    .ASM   DISK      .203     DUMP    .ASM   DISK      .313
DUMP    .ASM   DISK      .S-7     DUMP    .ASM   DISK      .S24
ED3     .ASM   DISK      .S15     EDUCATOR.ASM   DISK      .S16
EXAM    .ASM   DISK      .S15     EXPAND  .ASM   DISK      .S17
FASTLIST.ASM   DISK      .S-1     FASTLIST.ASM   DISK      .S31
FBIOS24 .ASM   DISK      .S25     FBOOT24 .ASM   DISK      .S25
FMAP    .ASM   DISK      .S26     FOCAL   .ASM   DISK      .S16
FORMAT  .ASM   DISK      .203     FORMAT  .ASM   DISK      .S-7
FORMAT  .ASM   DISK      .S25     FORMAT1 .ASM   DISK      .S26
FPP     .ASM   DISK      .S23     GO      .ASM   DISK      .S26
HEART   .ASM   DISK      .203     HEART   .ASM   DISK      .S-7
HYS13   .ASM   DISK      .S15     HYS15   .ASM   DISK      .S15
ICOPY   .ASM   DISK      .S15     IDIR    .ASM   DISK      .S15
INITPARM.ASM   DISK      .S-1     INTLIZE .ASM   DISK      .313
LETTER  .ASM   DISK      .S25     LINK    .ASM   DISK      .S27
LINK73  .ASM   DISK      .S27     LIOS    .ASM   DISK      .S15
LTG     .ASM   DISK      .S15     MAC4    .ASM   DISK      .S26
MALIBU  .ASM   DISK      .313     MAZE    .ASM   DISK      .S15
MEMTST  .ASM   DISK      .S15     MODEM   .ASM   DISK      .S25
MOVDOWN .ASM   DISK      .S16     PASCAL  .ASM   DISK      .S17
```

*Sample 3. The start of a listing of all of the assembly language source programs in MAST.CAT. *.ASM means to list every program in the catalog which ends with ASM.*

Reader Service—see page 257

# Digital Tape and File Management System for the 6800

*The CFM/3 software and TC-3 interface do the trick.*

*Don R. Woods*
*4749 Beacon St.*
*Orlando, FL 32808*

*Dexter S. French, Jr.*
*142 Stoney Ridge Drive*
*Longwood, FL 32750*

Is your Kansas City Standard getting you down?

As early buyers and proponents of the SWTP M6800 system, we had become discouraged with extreme load and save times at 300 baud. Even waiting for a binary load became excruciating, and we had no file management.

Floppy disk prices and software capability are improving, but $1000 is still a lot of money for many of us to justify. Then along came Peter Stark's article, "Thoughts on the SWTP Computer System" (August 1979), on cassette interfaces for the M6800. We found the JPC's 4800 baud TC-3 interface and their cassette file management software, CFM/3, and its many features most intriguing. After careful consideration, we bought the TC-3 interface and CFM/3 manual and listing.

Our cassette tape recorder provided the first problem. The TC-3's literature recommended the Radio Shack $80 cassette stereo record/play deck as a minimum requirement. Our Sears $39.95 special was, of course, not listed.

We made several attempts to save and load without success, even at the reduced rate of 600 baud. We broke out our home entertainment stereo tape deck, a Standard Radio model PRO 2000, and tried again. This time, we were successful on the first try at 4800 baud. Then, after a change of three bytes in the utility software, we tried it successfully at 7200 baud.

A bit cocky now, we tried at 9600 baud. This time, checksum errors sent us back to 4800 baud and its safety margin.

We purchased the CFM/3 for $19.95 as an instruction manual and listing for an EPROM resident version assembled at $C000 to $C7FF, with optional user command space from $C800 to $CFFF. An object code listing is available on cassette for $6.95, and a programmed EPROM for $69.95. JPC will program the customer's 2716 for an extra $20.

An extensively annotated source listing assembled at $7000 and object code listing for three versions came with the manual. (One EPROM version uses memory from $7F80 to $7FFF for stack, while another version uses $A080 to $A0FF and requires a modified memory board addressed as $A000.) The EPROM version is convenient for those with the SWTP A-2 CPU board, allowing CFM/3 access by simply typing Z while in SWTBUG.

After a few hours of entering object code (2K) from the keyboard, that $6.95 cassette price did not seem excessive at all.

We entered the $C000 version into our SWTP MP-R EPROM programmer buffer and promptly burned into a 2716. We got no response from CFM/3 until we remembered to address a memory board at $A000 for the stack.

Performance of the TC-3 and CFM/3 at this point was outstanding, especially considering that we had been limited to the SWTP SWTBUG and AC-30 cassette interface.

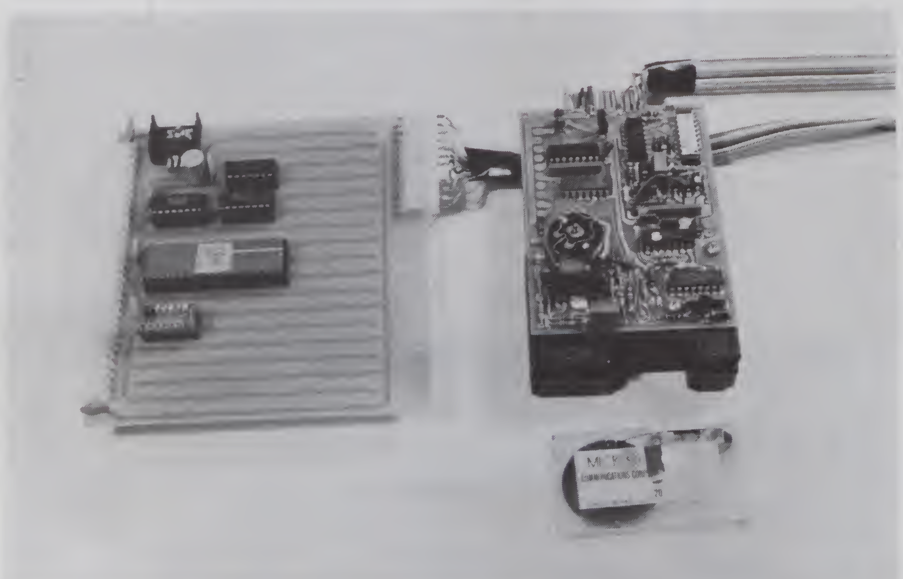


Photo 1. Micro read/write system, a tape wafer and the controller card.

### CFM/3 Features

Features of CFM/3 are described in Stark's article, but we'll recap them for convenient reference.

- CFM/3 is a cassette file manager and operating system for use with the JPC Products' TC-3 cassette interface board. It is available in both RAM memory and EPROM resident versions. The EPROM version is on a single 2716, which is installed in a socket on the A-2 CPU board.
- CFM/3 is fast: it operates at 4800 baud with an ordinary audio cassette deck. It has complete error detection logic for reliability.
- It also handles six character-named files and will search a cassette for a requested file. The DIR command provides a directory

of all files on a cassette, displaying name, file type and addresses.

- A Verify command allows the operator to ensure that a cassette file is error free.
- It handles linked files. Separate blocks of memory can be saved, loaded or run as a single file.
- In addition, AUTO-RUN, a transfer address, may be saved with the file for automatic execution when loaded by the run command.
- A copy command allows drive-to-drive copy on multi-drive systems.
- The CFM/3 supports BASIC and other system programs. BASIC can execute all CFM/3 operations. BASIC patches are supplied with CFM/3.
- It provides automatic tape motion control for one, two or three recorders. The command allows manual override of recorder operation.
- It includes memory manipulation commands: find a byte or word, compare memory blocks, move memory block, fill memory block, list memory block as hexadecimal or ASCII characters.
- Finally, it provides for a user command table. User commands may be added to EPROM version, since the user command table is not within CFM/3. User commands function exactly the same as CFM/3 commands.

JPC provides software patches with CFM/3 for SWTP 8K BASIC versions 2.2 (also works for 2.0) and 2.3, CORES editor/assembler and the TSC editor and assembler. The patches provide CFM/3 name file save and load functions, and also direct CFM/3 command access from the host program.

What more could we ask for in a cassette system? With the TC-3, CFM/3 and a stereo tape deck, we have 4800 baud, file management and motor control for a combined cost of approximately $150, excluding EPROM cost.

For one thing, software control of the tape deck would add considerably to the convenience. Although CFM/3 supports motor control (select one of three) of the cassette deck, we must still manually key rewind, play and record functions on the tape deck.

Then we saw an advertisement by Micro Communications Corporation for a low-cost digital tape transport system. The $125 price for the transport, complete with read/write and control electronics, demanded immediate consideration.

#### Tape Transport

The Micro transport is a simple mechanism consisting of a precision die-cast aluminum block in which are mounted a magnetic tape head, drive motor and capstan. The Micro wafer cartridge edge-loads into a slot in the block, and the capstan drives the tape at a single point.

*Photo 2. Packaged system with two drives.*

Normal tape read/write speed is three inches per second. Nominal fast-forward speed is nine inches per second. Sensors detect the write permit (file protection) marker on the cartridge label and the end of the tape (EOT/BOT) reflector on the tape.

#### Magnetic Tape Wafers

The Micro tape wafer is both simple and inexpensive (a fraction of the cost of digital cassettes and cartridges) and can neatly fit into a first-class mailer. A Micro magnetic wafer is a small, thin, continuous-loop cartridge containing a single reel of tape with the ends spliced together.

In operation, the Micro single-point drive pulls the tape from the center of the wafer reel, causing the entire reel to rotate. Thus, the tape automatically winds around the outside of the reel at the same rate at which it unwinds from the inside.

#### The Tape

The recording tape used in wafers is different from ordinary recording tape. The base is Mylar, and its magnetic coating is a low-friction dispersion of chromium dioxide, instead of ferric oxide. The back (nonrecording) side of the wafer tape is coated with low-friction, high-adhesive material that guarantees smooth tape motion. All digital wafers are certified for no errors at 3200 flux changes per inch (fci). Micro wafers are life-tested to exceed the published figures of small cassette tapes.

#### Storage Capacity

Wafers are available in five-foot increments of tape length from a minimum of five feet to a maximum of 50 feet. Fifty feet of magnetic tape stores 1.92 million flux changes at 3200 fci. If your encoding/decoding scheme uses a phase-encoding technique, you could store 120,000 bytes of information on a 50-foot wafer.

#### EOT/BOT and File Protect

In a continuous-loop cartridge the end is, of course, the beginning and EOT = BOT. Thus, only one EOT/BOT indicator is required in a wafer. That indicator is a piece of reflective tape that splices both ends together. The EOT/BOT sensor included with the tape system generates an output signal each time the reflective splice is encountered.

File protection (WP) is generated by a conductive, removable sticker on the wafer label. The presence of the sticker enables writing. You peel off the sticker from the label to protect the tape; when you want to write on the tape again, you paste on a new sticker.

#### Electronic Read/Write Tape System

The Micro read/write digital data storage system is a complete digital input/output system designed for use in storing and retrieving digital information that is encoded and decoded by the user. In addition to complete electronics, the electronic read/write system contains sensors for both EOT/BOT and write permit.

When coupled with a microprocessor or other CPU (or the appropriate hardware logic), an electronic read/write system becomes a complete serial data storage and retrieval system at a fraction of the

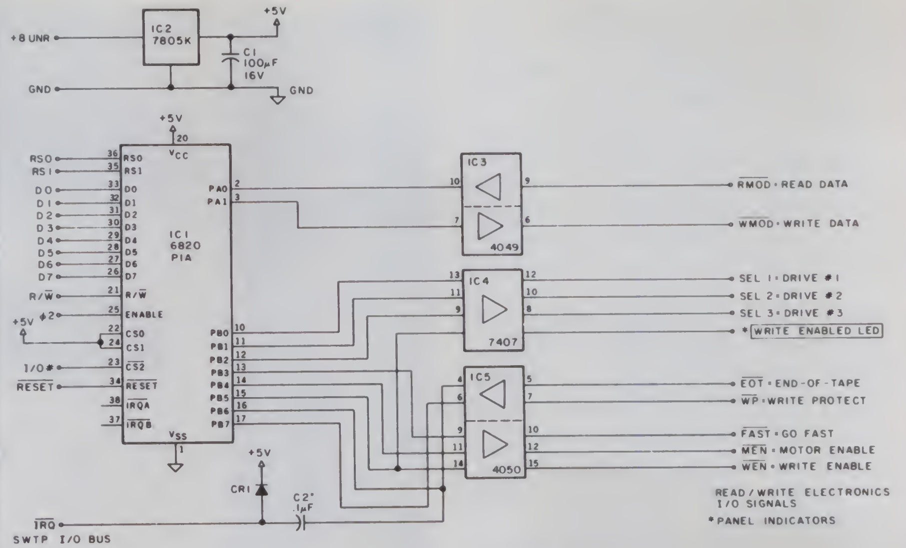



*Fig. 1. Micro drive interface circuit.*





usual cost. Because they leave the encoding and decoding to the user, the Micro electronic read/write system permits the use of any bit-serial, self-clocking code.

### Performance

The Micro electronic read/write system has distinct advantages. The input/output signals are TTL- and 5-volt-CMOS-compatible. All input/output signals are true digital logic levels. The analog circuit functions are completely transparent to the user.

The operating characteristics of the electronic read/write system are quite impressive, and certainly are more than you would expect from a low-cost digital tape system. Because of the high-packing densities, a transfer rate (using normal read/write speed of three inches per second) of 9600 fci is possible. The system can effect a 4800 baud transfer rate when reading and writing. The start time of the transport is 30 ms, while the stop time is 40 ms.

### Self-Clocking Codes

Because tape systems are basically mechanical assemblies, you cannot rely on those to maintain perfectly constant speed. To overcome this obstacle, a digital tape system must transmit a recorded clock signal along with the binary information. This information must be recorded together. Choosing a self-clocking code generally boils down to a compromise between tape storage and speed control.

### Hardware Interface

Full software control of the Micro tape transport requires the following I/O signals:

*Control inputs.* Write Enable (WEN) activates the head write current, Motor Enable (MEN) energizes the motor, FAST causes a faster than normal tape speed and Select (SEL) selects all output buffers and enables all other inputs.

*Status outputs.* End of Tape (EOT) indicates the presence of the EOT marker at the window of the Micro wafer cartridge, and Write Permit (WP) indicates the presence of the write permit marker on the label of the Micro wafer cartridge.

*Data lines.* A Write Modulation (WMOD) transition, when WEN is true, causes a flux transition to be written; a Read Modulation (RMOD) transition represents a flux transition read from tape.

Note that all I/O signals are active low. The hardware requirements to interface the Micro tape transport with the TC-3 and CFM/3 looked simple.

At this point, with great expectations and some anxiety concerning compatibility, we phoned in an order for the Micro transport. The order, including mounting brackets ($5 option) and a box of ten 20-foot wafers ($28), arrived COD in a little over two weeks.

For the initial interface, we simply removed the analog conditioning components from the TC-3 board to convert the data input/output signals to a digital logic level and connected them to the Micro transport electronics board with a +5 and +12 volt source. We verified the operation of the Micro cassette (actually, micro magnetic wafer) data storage and retrieval system by using a jumper for write enable select and a VOM to monitor the end-of-tape (EOT/BOT) status output.

The TC-3 could have been butchered with jumper wire (all required functions are present; however, input lines other than Data In are not buffered and connected to the PIA). We elected to customize our controller on a Percom prototype board using wire-wrap techniques. Photo 1 shows the Micro read/

write system, a tape wafer and our controller card.

CFM/3 is configured to provide a logic false (high) signal at the PIA outputs, which is consistent with the requirements of the Micro tape transport. However, we determined that the data (WMOD) output line had a quiescent true (low) when initializing a write. Since Micro's installation manual specifies that the first data input transition must be from the false state to the true state, we decided to provide inverting buffers for both the write modulation and the read modulation lines.

Operation without the signal inversion does not appear to cause any adverse effects; in fact, the read modulation data input phase to CFM/3 is not at all critical with respect to the write modulation phase. Photo 2 shows the packaged system with two drives.

Fig. 1 is a schematic diagram of our interface circuit. Note that a CMOS 4050 buffer is used for all transport I/O signals except read and write modulation, where the pin-compatible 4049 inverting buffer is used. An open collector TTL 7407 buffer is used for transport select, since it has an on-board 10k pull-up resistor on the select input. 7407s, with pull-up resistor packages, could just as well be used for I/O signal buffers. An open collector buffered write enable signal drives an indicator LED. The protoboard shown in Photo 1 contains all of the electronics shown in the schematic.

The EOT status is capacitively coupled directly to the system's maskable interrupt *bus rather than through* the PIA. This was a matter of expediency, since our system is not using any other interrupts at this time.

A word of caution: The unmodified version of CFM/3 will initialize the controller PIA outputs to "turn-on-the-world" with a true logic state to the transport for select, motor on, fast motion and write enable.

### Software Enhancements

To fully software-control the Micro transport, we made several modifications and added some features in CFM/3. We modified the Motor On and Motor Off routines to provide proper PIA strobing for Write Enable, if the write flag is set, and for transport de-select delay. We added a new prewrite routine to set up an interrupt service vector, move the tape beyond the BOT marker, check the wafer for Write Permit and set the write flag. The interrupt service routine prevents going past the EOT marker and overwriting an existing program on the tape.

Two new commands—EOT and ERASE—are added to CFM/3. EOT will cause the tape to advance at nine ips (FAST) until the EOT marker is encountered. ERASE will do the same thing, except that the tape will be erased to the EOT marker.

| CFM/3 ADDR | Original Code | New Vectors |
|---|---|---|
| $C002 | 7E C2A9 | 7E C908 |
| $C296 | 86 07BA | 7E C880 |
| $C29D | 0F B67F | 7E C89C |
| $C4E6 | BD C250 | BD C8AD |

*Table 1. Modifications and additions to CFM/3.*

### File Manager Description

The description of modifications and additions to CFM/3 in Table 1 goes with the assembled source, Listing 1. The software that drives the Micro cassette transport is in the form of an overlay patch to CFM/3 providing jumps to several revised and new routines.

As their names suggest, MOTON and MOTOF control the motor in the transport. The routine STWRTF is called before any writing operation is executed.

The MOTON routine controls the SEL (bit 0,1,2), MEN (bit 4) and the WEN (bit 5) inputs to the transport. The drive selected (SEL) is determined by the contents of buffer DRIVE, which has been loaded by CFM/3. Motor Enable (MEN) is set active low by the ANDA instruction, and, depending on the condition of the write flag (WRTFLG), the write enable (WEN) is set. The word that has been built in the A accumulator is then output to the B side of the PIA at port 4.

The MOTOF routine clears the SEL, MEN and WEN inputs to the transport in the proper order. First, however, the interrupt mask is set (interrupts disabled) and the index register stored (XBUF1). Next, the MEN (bit 4) is set high (off); then, after a 50 ms delay, the WEN and SEL bits are also set high (off), and, after clearing the write flag, the X register is restored (XBUF1).

The STWRTF routine sets up the interrupts and examines EOT and Write Permit (WP, bit 7) outputs from the transport to determine if the write flag ($A017) should be set. Follow through the routine from the beginning. First, the PIA is initialized and the interrupt vector is set up. Next, the motor is started by MOTON and EOT is examined for true low. If EOT is true, then the delay is initiated. This delay is deleted if EOT is already false.

In either case, at DONE1, the interrupt mask is cleared, and, after selecting the proper drive, the write permit input is examined. If WP (bit 7) is true low, then the write flag is set to $FF. If the WP is false, then the flag must not be set, and an error message to that effect is output.

The interrupt service routine (IRQSER) is an exit mode for any writing operation if the EOT marker is encountered. An error message is output, and control returns to

CFM/3 or to the calling program through CFM/3.

The two new commands, EOT and ERASE, use the subroutine FNDEOT. The FNDEOT routine first clears the write flag and then turns on the motor with the FAST (bit 3) set active low. At EOTYET, a loop is started to look for EOT (bit 6). By shifting left twice and watching carry, we are watching EOT. This loops to EOTYET until the carry is cleared (until EOT is true low) and the motor is shut off (MOTOF).

The EOT command calls FNDEOT as a subroutine directly, and, when done, control is returned to CFM/3 or the calling program through CFM/3. The ERASE command first calls STWRTF to set the write flag and then calls FNDEOT, but after the clear write flag instruction. From here on, the action is the same as the EOT command, except that termination will be by interrupt and an EOT error message.

The patches and overlay are assembled assuming CFM/3 is addressed starting at \$C000. In our case, it is in EPROM in an SWTP A-2 board. The extended command table is located from \$C800 to \$C810, and the new routines are resident from \$C880 to \$C939.

### Summary

Although we are still operating at 4800 baud, tests at 7200 and 9600 baud have been completely successful. We expect to change over in the near future when we become ambitious enough to rerecord our existing files; however, due to the software and leader/trailer overhead, speed is only improved by 30 percent when going from 4800 baud. Perhaps it's not worth the effort. After all, 8K BASIC loads in 20 seconds, including leader, at 4800 baud.

The ability to patch a BASIC interpreter for sequential data files with CFM/3 would be a nice feature. There are at least two possibilities. Jerry Williams, JPC, advises that Computerware has been commissioned to modify their cassette-based data file BASIC to work with CFM/3. Or, the disk data file routines of SWTP's BASIC 3.0 could be modified to substitute CFM/3 routines.

Exatron Corporation (see *Kilobaud Microcomputing*, the ad, "Stringy Floppy for SWTP," October 1979, p. 15; Bill Harvey's article, "The Exatron Stringy Floppy," same issue, p. 98; and Jim Perry's article "Stringy Floppy Encore," November 1979, p. 42) evidently uses the Micro Communications Corporation tape transport and magnetic tape wafers in its Stringy Floppy systems. An apparent difference is that Exatron's wafers are supplied uncertified (they also cost less than Micro's certified wafers) and must be user certified using their operating system Certify command.

Exatron's software is described as limited to "utility low-level drivers and an I/O package designed to reduce monitor dependency." Although they offer a user's manual and information package for evaluation, we have not succeeded in obtaining more than a single mimeographed sheet on the SWTP version. Based on currently available information and our experience, JPC's CFM/3 operating system, as modified herein, appears vastly superior to other tape systems.

The Micro tape transport and CFM/3 cassette file manager have been in service for nearly one year and have more than met our expectations for performance, reliability and convenience. ■

*We have been advised that Micro Communications Corporation has been acquired by Exatron Corporation, a major OEM user of the Micro tape transport and wafers. However, the micro read/write system is still available factory direct at \$135 (quantity one) and certified wafers at \$30 (quantity 10) from Micro Communications Corp., Exatron, Inc., 181 Commercial St., Sunnyvale, CA 94086, 800-538-8559.*

*Listing 1. Micro cassette driver for CFM.*

```
7F83                  DRIVE    EQU    $7F83
7F91                  MESSAG   EQU    $7F91
7FCF                  XBUF1    EQU    $7FCF
8012                  PRTB     EQU    $8012        B SIDE OF PORT 4
A017                  WRTFLG   EQU    $A017
C024                  CONTL    EQU    $C024
C250                  INITL    EQU    $C250
C791                  PBLANK   EQU    $C791
E07E                  PDATA1   EQU    $E07E
                      *
                               OPT    PAG
C880                           ORG    $C880
                      *
C880 0F               MOTOF    SEI                 SET IRQ MASK FIRST
C881 FF 7F CF                  STX    XBUF1        STASH X
C884 B6 80 12                  LDAA   PRTB
C887 8A 10                     ORAA   #00010000B   MEN OFF
C889 B7 80 12                  STAA   PRTB
C88C CE 18 6A                  LDX    #6250
C88F 09                        DEX                 DELAY 50 MS
C890 26 FD                     BNE    *-1
C892 8A 3F                     ORAA   #00111111B   WEN, SEL OFF
C894 7F A0 17                  CLR    WRTFLG       CLEAR THE WRITE FLAG
C897 FE 7F CF                  LDX    XBUF1        RESTORE X
C89A 20 0D                     BRA    MOT
C89C B6 7F 83         MOTON    LDAA   DRIVE        SEL
C89F 43                        COMA
```

```
C8A0 84 EF            ANDA   #11101111B    MEN ON (LOW)
C8A2 F6 A0 17         LDAB   WRTFLG        FF = WRITE
C8A5 27 02            BEQ    MOT           00 = READ
C8A7 84 DF            ANDA   #11011111B    WRITE BIT ON (WEN)
C8A9 B7 80 12  MOT    STAA   PRTB
C8AC 39               RTS
               *
               *      ROUTINE TO SET THE WRITE FLAG
               *
C8AD BD C2 50  STWRTF JSR    INITL
C8B0 CE C9 37         LDX    #IRQSER     SET UP INTERRUPT SERVICE VECT
C8B3 FF A0 00         STX    $A000
C8B6 8D E4            BSR    MOTON       FIRST GET BEYOND EOT
C8B8 B6 80 12         LDAA   $8012       CHECK EOT
C8BB 48               ASLA
C8BC 0C               CLC
C8BD 48               ASLA
C8BE 25 06            BCS    DONE1
C8C0 CE 80 00         LDX    #$8000      TIME DELAY TO CLEAR EOT
C8C3 09               DEX
C8C4 26 FD            BNE    *-1
C8C6 0E        DONE1  CLI                NOW CLEAR THE INTERRUPT MASK
C8C7 B6 7F 83         LDAA   DRIVE       GET WHICH DRIVE
C8CA 43               COMA               SEL ON (ACTIVE LOW)
C8CB B7 80 12         STAA   PRTB        MUST SEL WP FROM RIGHT DRIVE !
C8CE B6 80 12         LDAA   PRTB        WRITE PERMIT? (WP)
C8D1 48               ASLA               BIT 7 > CARRY
C8D2 25 2B            BCS    ERROR9      DISALLOW WRITE
C8D4 7F A0 17         CLR    WRTFLG
C8D7 73 A0 17         COM    WRTFLG      SET WRITE FLAG
C8DA 39               RTS
               *
               *      ROUTINE TO FIND EOT
               *
C8DB 7F A0 17  FEOT   CLR    WRTFLG
C8DE 8D BC            BSR    MOTON
C8E0 84 F7            ANDA   #11110111B    TURN ON 'FAST'
C8E2 B7 80 12         STAA   PRTB          BIT 3 = 'FAST'
C8E5 B6 80 12  EOTYET LDAA   PRTB
C8E8 48               ASLA
C8E9 0C               CLC                EOT = BIT 6
C8EA 48               ASLA               BIT 6 > CARRY
C8EB 25 F8            BCS    EOTYET
C8ED 8D 91            BSR    MOTOF
C8EF 39               RTS
               *
MICRO DRIVE     03/08   00:02:55       TSC MNEMONIC ASSEMBLER    PAGE 1
C8F0 8D E9     FNDEOT BSR    FEOT
C8F2 7E C0 24         JMP    CONTL
               *
C8F5 8D B6     COPY   BSR    STWRTF
C8F7 7E C0 B1         JMP    $C0B1       COPY
               *
C8FA 8D B1     SAVE   BSR    STWRTF
C8FC 7E C0 CD         JMP    $C0CD       SAVE
               *
C8FF CE C9 08  ERROR9 LDX    #ERMSG9     WP ERROR
C902 BD E0 7E         JSR    PDATA1
C905 7E C0 24         JMP    CONTL       RETURN TO CNTL & RESET STK
               *
C908 20        ERMSG9 FCC    / WP ERROR/
C909 57 50
C90B 20 45
C90D 52 52
C90F 4F 52
C911 04               FCB    4
               *
C912 FF 7F CF  EXSAV  STX    XBUF1         STASH X
C915 CE C7 91         LDX    #PBLANK       NULL MESSAGE
C918 FF 7F 91         STX    MESSAG        IN MESSAGE BUFFER
C91B 8D 93            BSR    STWRTF+3      SET WRT FLAG WITHOUT INITUL
C91D FE 7F CF         LDX    XBUF1         RESTORE X
C920 7E C2 A9         JMP    $C2A9         EXSAVE
               *
C923 8D 88     ERASE  BSR    STWRTF
C925 8D B7            BSR    FEOT+3
C927 7E C0 24         JMP    CONTL
               *
C92A 45        EOTER  FCC    /EOT ERROR */
C92B 4F 54
C92D 20 45
C92F 52 52
C931 4F 52
C933 20 2A
C935 07               FCB    7,4
C936 04
               *
               *      INTERRUPT SERVICE ROUTINE
               *
C937 0F        IRQSER SEI
C938 BD C8 80         JSR    MOTOF       DISABLE INTERRUPT MASK & STOP MOT
C93B CE C9 2A         LDX    #EOTER
C93E BD E0 7E         JSR    PDATA1      PRINT EOT ERROR MSG
C941 7E C0 24         JMP    CONTL       THIS RESETS STACK & CLEANS UP
               *
               *
               *
C800                  ORG    $C800
C800 C8               FCB    $C8,2
C801 02
C802 45               FCC    /EOT/       FIND EOT
C803 4F 54
C805 7E C8 F0         JMP    FNDEOT
C808 45               FCC    /ERASE/     ERASE TO EOT
C809 52 41
C80B 53 45
C80D 7E C9 23         JMP    ERASE
C810 80               FCB    $80
                      END
        NO ERROR(S) DETECTED

   SYMBOL TABLE:
CONTL  C024    COPY   C8F5    DONE1  C8C6    DRIVE  7F83
EOTER  C92A    EOTYET C8E5    ERASE  C923    ERMSG9 C908
ERROR9 C8FF    EXSAV  C912    FEOT   C8DB    FNDEOT C8F0
INITL  C250    IRQSER C937    MESSAG 7F91    MOT    C8A9
MOTOF  C880    MOTON  C89C    PBLANK C791    PDATA1 E07E
PRTB   8012    SAVE   C8FA    STWRTF C8AD    WRTFLG A017
XBUF1  7FCF
```

# Ask for Instant Software at a computer store near you.

**Alabama**
Anderson Computers
3156 University Dr., Huntsville
Computerland of Huntsville
3020 University Dr., Huntsville
Olensky Bros.
3763 Airport Blvd., Mobile

**Arizona**
Professional Data Systems
4506-A N. 16th St., Phoenix
Millets TV & Radio
621 East Broadway, Mesa

**Arkansas**
Dr. James A. Copps
1215 So. Thompson St., Springdale

**California**
AMCO Elect. Supply
635 E. Arrow Hwy., Azusa
Byte Industries
3501 Arden Rd., Hayward
Byte Shop
8038 Clairmont Mesa Blvd., San Diego
Byte Shop
123 E. Yorba Linda, Placentia
Byte Shop of Mt. View
1415 West El Camino Real, Mt. View
Byte Shop of Sacramento
6041 Greenback Ln., Citrus Heights
Capital Computer Systems
3396 El Camino Ave., Sacramento
Coast Electronics
6905 Alcameno Real, Altascadero
Coast Electronics
2360 N. Main St., Morro Bay
Computers Made Easy
819 East Ave. Q-9, Palmdale
Computer Store of San Leandro
701 MacArthur Blvd., San Leandro
Computer World
6791 Westminster Ave., Westminster
Computerland
16720 S. Hawthorne, Lawndale
Computerland of W. LA
6840 La Cienega Blvd., Inglewood
Coast Electronics
3118 No. Main St., Morro Bay
Computerland
24001 via Fabricante No 904, Mission Viejo
Computer Mart of California
315 Diamond Bar Blvd., Diamond Bar
Electronic Systems
4883 Tonino, San Jose
Hobbi-tronics
1378 So. Bascom Ave., San Jose
Hobby World
19511 Business Ctr. Dr., Unit 6, Northridge
Huntington Computing
2020 Charles St., Corcoran
Jade Computer Products
4901 W. Rosecrans, Hawthorne
Malibu Microcomputing
23910A Deville Way, Malibu
Marlam Co.
6351 Almaden Rd., San Jose
Opamp/Technical Books
1033 N. Sycamore Ave., Los Angeles
PC Computers
10166 San Pablo Ave., El Cerrito
Q.I. Computers, Inc.
15818 Hawthorne Blvd., Lawndale
Radio Shack Dealer
8250 Mira Mesa Blvd., San Diego
Radio Shack Dealer
50 N. Cabrillo Hwy., Half Moon Bay
Santa Rosa Computer Center
604 7th St., Santa Rosa
Silver Spur Elect. Comm.
3873 Unit F, Schaefer Ave., Chino
The Computer Store
820 Broadway, Santa Monica

**Colorado**
Apparat Inc.
4401 South Tamarac Pky., Denver
Colorado Computer Systems
311 W. 74th Ave., Westminster
Computerland of North Denver
8749 Wadsworth Blvd., Arvada
Computer Shack
1635 South Prairie, Pueblo
Software Gourmet
1111 S. Pearl St., Denver
The Computer Store
2300 Welton St., Denver

**Connecticut**
American Business Computers
454 Thames St., Groton
Computerlab
130 Jefferson, New London
Computerland
1700 Post Rd., Fairfield
Computerland
60 Skiff St., Hamden
Computer Works
1439 Post Rd. E., Liberty Plaza, Westport
Diversified Electronics
2 Amity Rd., New Haven
Instructional Systems Computers
807 Hartford Rd., Manchester
Technology Systems
208 Greenwood Ave., Bethel

**D.C.**
The Program Store
4200 Wisconsin Ave., N.W., Washington, D.C.

**Florida**
Al Personal Computer
178 Oxford Rd., Fern Park
AMF Microcomputer Center
11158 N. 30th St., Tampa
Computer Junction
5450 So. State Rd. 7, Ft. Lauderdale
Computerland
7374 S. Tamiami Trail, Sarasota
Computerland of Ft. Lauderdale
3963 N. Federal Hwy., Ft. Lauderdale
Computerland of Jacksonville
2777-6 University Blvd. W. Jacksonville
Computerland of Tampa
1520 E. Fowler Ave., Tampa
Computerland of West Palm Beach
4275 Okeechobee Blvd., West Palm Beach
Computer Shack
3336 Beach Blvd., Jacksonville
Computer System Resources Inc.
3222 S.W. 35th Blvd., Gainesville
Curtis Waters Enterprises
236 Talbot Ave., Melbourne
Heath Kit Electronic
4705 W. 16th Ave. Center, Hialeah
HIS Computermation
1295 Cypress Ave., Melbourne
South East Micro Data
6220 S. Orange Blossom Trail, Suite 602, Orlando
Williams Radio & TV Inc.
2062 Liberty St., Jacksonville
Your Basic Computer Store
2729 So. US 1, Suite 11, Fort Pierce

**Georgia**
Atlanta Computer Mart
5091 Buford Hwy., Atlanta
Computerland of Atlanta
2423 Cobb Parkway, Smyrna
Micro Computer Systems
3104 E. Shadowlawn N.E., Atlanta

**Hawaii**
Computerland of Hawaii
567 N. Federal Hwy., Honolulu
Radio Shack Assoc. Store
1712 S. King St., Honolulu

**Idaho**
Electronic Specialists
8411 Fairview Ave., Boise

**Illinois**
Computerland
4507 North Sterling, Peoria
Computerland
9511 N. Milwaukee Ave., Niles
Computer Station
3659 Nameoki Rd., Granite City
Garcia & Associates
203 No. Wabash Ave., Suite 1510, Chicago
Midwest Micro Computers, Inc.
708 S. Main St., Lombard

**Indiana**
Computer Center of South Bend
51591 US 31 North, South Bend
Data Domain
221 W. Dodds, Bloomington
Fall Creek Electronics Store
732 Center St., Pendleton

**Iowa**
Memory Bank
1721 Grant St., Bettendorf

**Kansas**
Central Kansas Computers
6 S. Broadway, Herington

**Louisiana**
Computer Shoppe Inc.
3225 Danny Pk., Metairie

**Maine**
Maine Computronics
Intown Plaza, Bangor
Mid Maine Computer Co.
158 Turner St., Auburn
Radio Shack
315 Main Mall Rd., So. Portland

**Maryland**
Computer Age
9433 Georgia Ave., Silver Springs
Jack Fives Electronics
4608 Debilen Circle, Pikesville
The Comm Center
9624 Ft. Meade Rd., Laurel

**Massachusetts**
ComputerCity
175 Main St., Charlestown
ComputerCity
50 Worcester Rd., Framingham
Computer Packages Unlimited
342 Boston Turnpike, Shrewsbury
Land of Electronics
1127 Western Ave., Lynn
Lighthouse Computer Software
14 Fall River Ave., Rehoboth
Mark Gordon Computers
15 Kenwood St., Cambridge
Small Business System Group
Main St., Dunstable
The Computer Store
120 Cambridge St., Burlington
Tufts Radio & Electronics
206 Mystic Ave., Medford

**Michigan**
Computer Center
28251 Ford Rd., Garden City
Computer Connections
38437 Grand River, Farmington Hills
Computerland of Grand Rapids
2927 28th St. S.E., Kentwood
Computerland of Southfield
29673 Northwestern Hwy., Southfield
Computer Mart
560 W. 14 Mile Rd., Clawson
Computer Room
455 E. Michigan Ave., Kalamazoo
Computronix Corp.
423 S. Saginaw Rd., Midland
Hobby House
1035 W. Territorial Rd., Battle Creek
Main Systems Inc.
1161 No. Ballenger Hwy., Flint
The Alternate Source
1806 Ada, Lansing
The Eight Bit Corner
722 Evanston Ave., Muskegon
TRI Country Electronics & Sound Center
1537 North Leroy, Fenton
Ye Olde Teacher Shoppe
1823 Witmyre St., Ypsilanti

**Minnesota**
Computerland of Hopkins
11319 Hwy F., Hopkins
Digital Den
Burnsville Center
Minnesota Software Inc.
5422 Fisher St., White Bear Lake
The Code Room
18216 Ginavale Lane, Eden Prairie
Zim Computers
5717 Xerxes Ave., N. Brooklin Center

**Mississippi**
Dyer's, Inc.
200 E. Main St., West Point
Softwarehouse
816 Foley St., Jackson

**Missouri**
Century Next Computers
1001 E. Walnut, Columbia
Computer Center
212 W. 4th St., Joplin
Comp-U-Trs Software Center
51 Florissant Oaks Shopping Center, Florissant
Software Shack
16501 Greenwald Court, Belton

**Montana**
Intermountain Computer
529 So. 9th St., Livingston
Personal Computer
121 Red Oak Dr., Carl Junction
The Computer Store
1216 16th St. W. #35, Billings

**Nebraska**
Computerland of Omaha
11031 Elm St., Omaha
Midwest Computer Co. Inc.
8625 I St., Omaha
Midwest Computer Co. Inc.
4442 S. 84th St., Omaha
Midwest Computer Co. Inc.
4403 S. 87th St., Omaha
Scottsbluff Typewriters Inc.
1824 Broadway, Scottsbluff

**Nevada**
Century 23
4566 Spring Mountain Rd., Las Vegas
Hurley Electronics
1112 S. Casino Center, Las Vegas

**New Hampshire**
Bitsnbytes Computer Center
568 Pleasant St., Concord
ComputerCity
1525 S. Willow, Manchester
Paul's TV
Main St., Fremont
Portsmouth Computer Center
31 Raynes Ave., Portsmouth
Radio Shack Assoc. Store
Fairbanks Plaza, Keene
Sturdivant and Dunn
124 Washington St., Conway

**New Jersey**
Abe's TV Sales & Service
College Town Shopping Center, Glassboro
Computer Corner of NJ
439 Rte. #23, Pompton Plains
Computer Encounter
2 Nassau St., Princeton
Computerland
35 Plaza Rte. #4, W. Paramus
Computer Mart of NJ
501 Rte. 27, Iselin
Crowley's
Rd. #3, Whitehouse Station
Dave's Electronics
Pennsville Shopping Ctr., Pennsville
GHB Enterprises Inc.
Rte. 38, Rudderaw Ave., Mapleshade
Lashen Electronics Inc.
21 Broadway, Denville
Personal Computing Inc.
51 Central Sq., Linwood
Radio Shack/J&J Electronic
Mansfield Shopping Ctr.
Rt. 57 Allen Rd., Hackettstown
Radio Shack Assoc. Store
Moorestown Mall, Moorestown
The Bargain Brothers
Glen Roc Shopping Center
216 Scotch Road, Trenton
The Computer Emporium
Bldg. 103, Avenues of Commerce
2428 Rte. 38, Cherry Hill

**New Mexico**
Autel Electronics Co.
146 Wisconsin NE, Albuquerque
South West Computer Center
121 Wyatt Drive, Suite 7, Las Cruces
Thomas E. Carr Jeweler
1300A Tenth St., Alamogordo

**New York**
Aristo Craft
314 Fifth Ave., NYC
Berliner Computer Center
102 Jericho Turnpk, New Hyde Park
Computer Corner
200 Hamilton Ave., White Plains
Computer Era Corp.
1570 3rd Ave., New York
Computer Factory
485 Lexington Ave., NYC
Computerland of Nassau
79 Westbury Ave., Carle Place
Computerland of New York City
58 W. 44th St., New York
Computer Resources
5560 Main St., Williamsville
Computer World
519 Boston Post Rd., Port Chester
Comtek Electronics, Inc.
2666 Coney Island Ave., Brooklyn
Comtek Electronics, Inc.
Staten Island Mall
Store 220A, Staten Island
Digibyte Systems Corp.
31E. 31st St., New York
80-Microcomputer Services
118 Masten Ave., Cohoes
Future Visions Computer Store
70 Broad Hallow Rd., Melville
Home Computer Center
671 Monroe Ave., Rochester
Mr. Computer
Imp. Plaza, Rte. 9, Wappingers Falls
Softron Systems
308 Columbia Turnpike, Rensselaer
The Computer Tree Inc.
409 Hooper Rd., Endwell
Upstate Computer Shop
629 French Rd., Campus Plaza, New Hartford

**North Carolina**
Byte Shop of Raleigh
1213 Hillsborough St., Raleigh
Sound Mill
Slocum Shopping Ctr., Havelock

**Ohio**
Altair Business Systems, Inc.
5252 North Dixie Dr., Dayton
Astro Video Electronics
504 E. Main St., Lancaster
Cincinnati Computer Store
4816 Interstate Dr., Cincinnati
Computerland
4579 Great Northern Blvd.,
N. Olmstead
Computerland
6429 Busch Blvd., Columbus
Computerland
1288 Som Rd., Mayfield Heights
Computerland
2000 North Rd. SE, Warren
Computer Store of Toledo
18 Hillwyck Dr., Toledo
H. Gabriel & Co.
1469 Rosena Ave., Madison
Microcomputer Center
7900 Paragon Rd., Dayton
Micro-Mini Computer World
74 Robinwood, Columbus
21st Century Shop
16 Convention Way, Cincinnati
Universal Amateur Radio, Inc.
1280 Aida Dr., Columbus

**Oklahoma**
Sounds, Etc.
Hyw 33, Watonga
Vern Street Products
114 W. Taft St., Sapulpa

**Oregon**
Computerland of Portland
12020 S.W. Main St., Tigard
Computer Pathways Unlimited, Inc.
2151 Davcor St. S.E., Salem
TRS-80 Products Ltd
3520 S.E. Vineyard Rd., Portland

**Pennsylvania**
Artco Elect.
302 Wyoming Ave., Kingston
Artco Elect.
Back Mountain Shopping Center, Shavertown
Audio Mart
518 Fifth Ave., New Brighton
Computer Workshoppe
3848 William Penn Hwy, Monroeville
Computerland of Harrisburg
4644 Carlisle Pike, Mechanicsburg
Computerland of Pittsburgh
5499 William Flynn Hwy., Gibsonia
Erie Computer Co.
2127 West 8th St., Erie
J + E Communications
617 3rd Ave., Duncansville
Mighty Byte Computer Center
537 Easton Rd., Horsham
Personal Computer Corp.
24-26 West Lancaster Ave., Paoli
Personal Computer Corp
Frazer Mall, Lancaster Ave., Frazer
Pittsburgh Computer Store
2945 Banksville Rd., Pittsburgh

**Rhode Island**
Computer City
165 Angell St., Providence
Digital World, Inc.
329 Bald Hill Rd., Warwick

**Tennessee**
ACS
1100 8th Ave. So., Nashville
Computerlab
671 S. Menden Hall Rd., Memphis
Computer World
625 Main St., Nashville
H & H Electronics Inc.
509 N. Jackson St., Tullahoma

**Texas**
Computerland of S.W. Houston
6439 Westheimer, Houston
Computer Port
2142 N. Collins, Arlington
Houston Computer Tech
5313 Bissonet, Bellaire
Interactive Computer
7620 Dashwood, Houston
K.A. Elect.
9090 Stemmons Frwy., Dallas
Pan American Elect. Inc.
1117 Conway, Mission
Radio Shack Dealer
21969 Katy Freeway, Katy
The Compute Shop
6353 Camp Bowie Blvd., Ft. Worth
Waghalter Books Inc.
3 Greenway Plaza E., Houston

**Utah**
DC Computer Co.
1911 West 70 South, Provo
Quality Technology
470 E. 2nd So., Salt Lake City

**Virginia**
Computer Works
Rte. 6, Box 65A, Harrisonburg
Home Computer Center
2927 Virginia Beach Blvd.
Virginia Beach
Southside Radio Comm.
135 Pickwick Ave., Colonial Heights

**Washington**
American Mercantile Co. Inc.
2418 1st Ave. S., Seattle
Byte Shop of Bellevue
14701 N.E. 20th St., Bellevue
Computer Connection Inc.
3100 NW Bucklin Hill Rd., Silverdale
Computerland of South King Co.
1500 S. 336 St., Suite 12, Federal Way
Personal Computers
S 104 Freva, Spokane
Ye Old Computer Shop
1301 G. Washington, Richland

**West Virginia**
The Computer Corner Inc.
22 Beechurst Ave., Morgantown

**Wisconsin**
Byte Shop Of Milwaukee
6019 West Layton Ave., Greenfield
Computerland
690 S. Whitney Way, Madison
Computerworld
3015 W. Wisconsin Ave., Appleton
Magic Lantern Computed
3313 University Ave., Madison
Petted Microsystems
4265 W. Loomis Rd., Milwaukee

**Wyoming**
Computer Concepts
1104 Logan Ave., Cheyenne

**Puerto Rico**
The Microcomputer Store
1568 Ave. Jesus T. Pinero
Caparra Terrace

**Canada**
CANADIAN DISTRIBUTOR:
Micron Distributing
409 Queen St., W. Toronto, Ont.
M5V 2A5
Computerland of Winnipeg
715 Portage Ave., Winnipeg, Man.
Compumart
411 Roosevelt Ave., Ottawa, Ontario
Micromatic Systems Inc.
1303 Powell St., Vancouver
Micro Shack of W. Canada
333 Park Street, Regina, Sask.
Orthon Holdings Ltd.
12411 Stony Plain Road
Edmonton, Alberta
Total Computer Systems
Ajax, Ontario

**Instant Software™**
PETERBOROUGH, NEW HAMPSHIRE 03458

# Merry Christmas From Your TRS-80*

Designed for use on TRS-80* 16K LEVEL II

# COMPU CAROLS

FEATURING SOUND

**ORDER NO. 0036R $9.95**

Here is a selection of all time Christmas favorites. These beautiful Christmas Carols will be displayed verse-by-verse, accompanied by clear, soft music on your TRS-80. The pretty music for each carol is played for your enjoyment over an AM radio, easily hooked up to your TRS-80. This lovely Christmas Album will bring hours of enjoyment from your Micro. The soft musical notes offer an ideal Christmas setting, seeming to blend perfectly with gently falling snow, as the flickering flames from the fireplace logs reflect from each glowing ornament on the tree. We wish you much enjoyment with Compucarols and a MERRY CHRISTMAS!

### 12 OF THE BEST LOVED SONGS OF CHRISTMAS

(1) AWAY IN A MANGER
(2) DECK THE HALLS
(3) GOD REST YE MERRY GENTLEMEN
(4) HARK! THE HERALD ANGELS SING
(5) JINGLE BELLS
(6) JOY TO THE WORLD
(7) NOEL
(8) O COME ALL YE FAITHFUL
(9) O LITTLE TOWN OF BETHLEHEM
(10) SILENT NIGHT
(11) WE THREE KINGS
(12) WHAT CHILD IS THIS?

**TO ORDER:**
1) See your local Instant Software Dealer
OR
2) Call toll-free 1-800-258-5473

Instant Software™

*A trademark of Tandy Corporation

PETERBOROUGH, N.H. 03458 603-924-7296

# SAVE YOUR TIME ...AND YOUR MONEY.

## Instant Software has the two best mail list programs available for your TRS-80 Model I and Model II.

### Mail/List for Model I and Model II

This mailing list program maintains separate alphabetical and zip code files in *constant sort*. When you add a name to your list, it will *automatically* be inserted into its correct position in the files; therefore it's always ready to print labels!

It will record your information in these fields: NAME, ADDRESS, CITY, STATE, ZIP, PHONE NUMBER, PHONE EXTENSION and a five character CODE field. You have the choice of a 3 line, 4 line, or user defined label format. It can even include (optionally) a message line on your label!

The programs most outstanding feature is its sorting capabilities. Mail/List allows you to choose which names you want to be printed from the whole list. For example, all people in one zip code, or all people named Jones, who are living in a particular city or state. For any name in your list you can assign a code within the CODE field. You can then specify the code when printing labels, and only names with that code will be printed out. You can specify up to 9 different codes!

Every business and organization will save time and money with Mail/list to keep track of customers or members.

**TRS-80 Model I version, Order No. 5000RD $99.00.**
Requires 16K RAM, Expansion Interface with at least 16K RAM, one disk-drive and a printer.

**TRS-80 Model II version, Order No.5001RD $199.00.**
Requires 64K RAM and printer.

### One-D Mailing List

Here is a mailing list system that can be run on only ONE disk-drive! You can have up to 17 fields of selection for name/address retrieval.
•Disk versatility allows you to add, delete, or change the numerous details stored in the system.
•Features of the One-D Mailing List includes:
•Automatic name sort (alphabetically or by ZIP code). •Rapid access to any name on file. •Easy error correction and recovery. •Prints selective name listings. •Revise or update listings at any time. •Up to 2500 names on-line (with 4 drives). •Prints a list of all names on file. •Prints mailing labels.
This package requires the following minimum system: 1. A TRS-80 Model I Level II microcomputer with 16K RAM. 2. An Expansion interface with 0 to 32K of RAM. 3. A single disk drive (extra drives optional). 4. A printer. 5. Any TRSDOS compatible Disk Operating System.

**Order No. 0123RD $24.95.**

WRITE FOR OUR NEW CATALOG

TO ORDER: See Your Local Instant Software Dealer or Call Toll-Free 1-800-258-5473.

✓40

Instant Software™

PETERBOROUGH, N.H. 03458

# Dial-up Directory

*A look at the ST80 series of data communications programs for the TRS-80.*

*Frank J. Derfler, Jr.*
*PO Box 691*
*Herndon, VA 22070*

Merry Dial-up and welcome to my holiday party. The featured Santa at this party has the coolest TRS-80 data communications programs in town. We will also take a look at some direct-connection modems and other goodies that will put a lump in your stocking.

**ST80**

I have been hearing about the ST80 series of data communications programs for the Radio Shack TRS-80 for a year. The author, Lance Micklus, has been begging off on a review until the "right time."

Well, the time is right now. Lance has gotten his series of programs in order, and I can now describe them to all of you out there who would like to use your TRS-80s as terminals for data communications.

The ST80 series is made up of three programs for the TRS-80 Model I/III and one for the TRS-80 Model II. The programs differ in the number of features they give your handy Tandy terminal and, of course, in the cost.

The most elementary program is called the ST80-UC. The UC stands for universal communications. This program can best be described as a terminal emulator. It makes your TRS-80 think it is a terminal with most of the standard terminal features (plus a few surprises I'll mention shortly). It will run on a Level II system with 4K or more memory and comes on tape in two versions—one for high memory and one for low. Disk system users can use a standard utility program to load the high-memory tape version to disk.

A TRS-80 running under ST80-UC will have full cursor control and scrolling. It will transmit control codes, escape, left and right brackets, repeat, rub out and an extended null break. The video driver program is compatible with all popular lowercase modifications. The program will also drive the TBEEP2 audio device manufactured by Web Associates. This provides the bell function found on video terminals.

The ST80-UC terminal features I have described so far are standard. There is one nonstandard feature that can be very useful—the sleep beep. Hams will recognize it as auto-start. The computer will remain in a monitor mode, not displaying anything until it receives a preset string in through the RS-232 port. When it recognizes its string, it wakes up, says "beep" (it even prints it on the screen) and displays any input. A string of Z's puts it back to sleep after it receives and displays a message. This provides you with an automatic message recording service. It can be used with telephone inputs (with an auto answer modem) or on an amateur radio link.

The ST80-UC is available in versions to run with the TRS-80 serial board, the Lynx direct-connection modem and the Micro-Connection. The price is $25.

The ST80-UC gives you a terminal with no memory. (That is my definition of a dumb terminal.) Lance Micklus calls it "half smart" because of the cursor addressing and other features. The ST80 series has a program that will turn your TRS-80 into a true "smart terminal" by anyone's definition.

ST80-III is an ultimate program. It is the heavy-duty workhorse that will get your TRS-80 Model I or Model II into (almost) any system. It does everything the UC version does. It is a disk-based system that can save anything it receives on disk and call it out for later review, manipulation, editing or retransmission.

ST80-III uses a software translation table which is easily modified from the keyboard. The translation table is the key to the flexibility of the program because everything is filtered through it. This means you can customize your TRS-80 to serve as a terminal for practically any computer system. Since the customizing is all done in software, you need only change disks to be perfectly meshed with the different host systems you may use.

The degree of customizing is significant. You can change the effect of received control characters on the video display. You can remove or alter control characters that might otherwise interfere with the operation of your printer or other peripherals. You can define ten special-purpose keys so that the proper command is conveniently sent with just one keystroke. You can give the translation table your log-on, password and usual beginning data, and it will send them automatically.

The program lets you set all transmitted parameters such as line feeds, nulls and even echo for working TRS-80 to TRS-80 direct. All of the serial board parameters are keyboard selected and stored in software. The program also has the transmission prompt feature, which is a must for working with IBM and some Harris computers.

ST80-III has two unique security features. The first is a file scrambler. All files (program, data, etc.) are transmitted as ASCII files. Any of these files can be scrambled by a random number generator driven by a 25-character passwood. Of course, another program is available to reverse the process —providing you get the password exactly right.

Lance estimates that after working on the encrypted file for 40 centuries, you might have a 50 percent chance of breaking it. Industrial espíonage being what it is, this kind of file encryption is one way to stop leaks. Other folks in less risky businesses might want to play with the encryption process or use it to send love letters, but if you forget the password or enter it incorrectly, don't call Lance. There is *no* way to recall it. Hams, remember that the use of encryption on the ham bands is not legal.

The second security feature consists of a built-in program serial number that can be interrogated from the far end. This can be used in two ways that I can think of right now. Various systems you check into can interrogate your program and compare your serial number with one you stored earlier. Then they know it is really you, and will deliver messages and data addressed to you.

Also, a canny software distributor could arrange with certain systems to interrogate users and then provide a list of names and numbers. The distributor would then know who had violated the contract (the software license) by making program copies for other than their own use.

ST80-III is available in versions for both the Model I/III and Model II TRS-80s. The Model I/III version costs $150, and Model II (CP/M or TRSDOS) costs $200.

Obviously, ST80-III is a bit more than the average hobbyist needs. There is another program between the $25 UC and $150 III. I skipped it because it was easier to describe the III first and then tell you what the lesser program doesn't do. The middle program is called the ST80-D; it is sometimes marketed as the ST80-II.

The D version does not have the security features. It does not have prompted transmission, so it will not work with many commercial mainframe computers. The auto log-on feature is limited and will probably only work with simple hobby systems. ST80-D is available only for the Model I TRS-80 with disk. It costs around $85.

All of the *ST80* programs come with some utilities. The UC comes with a program in the public domain called Message BASIC. This allows you to compose messages offline and have them ready to send when you make your connection. ST80-D and ST80-III have file-handling utilities that allow you to get the checksum of a file (is it all there?), tell the type of a file and do other similar functions.

Lance says one of his next projects is an ST80 extension which will parallel a distant user across the TRS-80's keyboard for game playing and education. Lance is also working on a version of ST80-III for the Heath H-89.

The ST80 series has been constantly updated and is well supported. These programs can provide tremendous power and flexibility for your dial-up operations. All ST80 programs are available from Small Business Systems Group, 6 Carlisle Rd., Westford, MA 01886, 802-863-4588.

Also, Houston Micro-Computer Technologies has been advertising complete Source/MicroNet packages including system membership, a modem and an ST80 program at good prices.


*The D-CAT is the familiar CAT modem in a direct-connection version. It is wired in between a standard telephone handset and the phone body and avoids the noise and distortion problems of acoustic coupling.*

### Direct Connection

Have you noticed all of the direct-connection modems in the new products section of *Microcomputing*? This term refers to how the modem hooks up to the phone line. A direct-connection modem just plugs into the phone jack. An acoustic modem has cups to accept the phone handset.

Direct connection reduces portability, but I don't believe too many of us carry our systems around much. Acoustic coupling has no advantage other than portability and the fact that the modems don't have to go through an FCC certification process. This process is expensive and has raised the price of direct-connection modems. The manufacturers have recently gotten a handle on this certification, and we have seen many direct-connection modems coming out at prices competitive with the acoustic type.

Novation has a direct-connection version of the famous CAT modem called the D-CAT. The D-CAT lists for $199 and features controls for a special hold function and complete self-test. It is a neat little package that can slip in right under the phone. The D-CAT is connected between the phone handset and the phone itself using the standard modular plugs. If you have an older phone without the modular plugs, you can probably trade it in for a new one or install it using modular plugs you buy yourself.

Emtrol Systems, Inc., has introduced a direct-connection modem that hooks into the TRS-80 without using the expansion interface. The Lynx modem goes between the phone and the wall, again using modular plugs and jacks.

The Lynx operates in either the originate or answer modes and can plug into either the TRS-80 keyboard or the expansion interface. It cannot be used, however, with the Radio Shack RS-232 board in place.

My initial inspection of the Lynx shows it to be a well-designed and well-made piece of equipment supported by good software. The company that makes it has been in business for over 20 years and is well-known in the area of industrial controls. If it meets your needs, don't hesitate to order a Lynx to fill your Christmas stocking. It sells for $239.95 from Emtrol Systems, Inc., 1262 Loop Road, Lancaster, PA 17601.

I introduced the Micro-Connection in a previous column (October). It is also a direct-connect modem that works with the

TRS-80 without the need of an expansion interface box. In addition, the Micro-Connection provides a separate RS-232 output that can be used with or without the modem function, but you may want to order a special version of ST80 series software to get the most out of this device. It sells for about $250 with dumb-terminal software.

Modtech, Inc., has started to make a series of reasonably priced direct-connection modems for RS-232-equipped systems. Their M103 is originate-only and lists for $216. They have an originate/auto-answer M-103A for $316.

Racal-Vadic has come out with a complete modem housed inside a standard telephone. Their ModemPhone simply hooks up to the computer or terminal and is ready to use. It comes in an originate-only model for $250 and an originate/auto-answer for only $330. This is a good price when you consider you get a phone too. Racal-Vadic is at 222 Caspian Drive, Sunnyvale, CA 94086.

Direct connection is the way modems are moving. I predict the demise of acoustic coupling. Does that mean that all of us with acoustic-coupled modems need to update? Indeed no. All of those acoustic couplers out there will continue to work as well as they ever have.

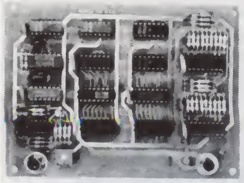
But if you have been having any distortion problems, you may be interested in another new product from Novation. Their Super Mike is an FCC-approved condenser microphone that replaces the carbon microphone in most common handsets. They claim it greatly reduces distortion. It sells for $9.95.

**Season's Greetings**

This completes one year as author of Dial-up Directory. If you have any comments, please mail them to PO Box 691, Herndon, VA 22070. Include a stamped envelope if you want a reply. Electronic mail is welcome through the AMRAD CBBS (703-734-1387), to TCB967 on The Source or 70003, 455 on MicroNet.■

# MICRO MISCELLANY FROM JBE

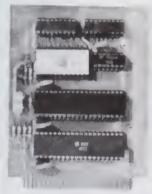
## A to D D to A CONVERTER



The JBE A-D and D-A Converter can be used with any system having parallel ports, and interfaces with JBE Parallel I/O Card (see below). A-D conversion time is 20µS, D-A conversion time is 5µS. Uses include speech, music synthesizing, slow scan TV, and joystick or paddle control inputs. Uses single power supply (5V), see JBE 5V power supply below. Parallel inputs and outputs include 8 data bits, strobe lines and latches. Analog inputs and outputs are medium impedance zero to five volt range.

79-287 ASSM. **$79.95**
KIT **$59.95**
BARE BOARD **$29.95**

## 6502 MICRO-MICROCOMPUTER



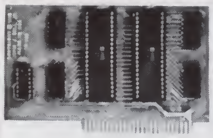
This JBE 3½x5" Micro-Microcomputer has the following:

- 1024 Bytes of RAM (two 2114s)
- 2048 Bytes of EPROM (2716)
- Uses one 6522 via (documentation inc.)
  - 2 8-bit bidirectional I/O ports
  - 2 16-bit programmable timer/counters
  - Serial Data Port
  - Latched output and input with handshaking logic.
  - TTL and CMOS compatible

The 6502 Microprocessor is particularly suited for control functions such as temperature control, burglar alarm, electric wheelchair, lights, etc. This Micro-Micro interfaces with the JBE Solid State Switch and A-D and D-A Converter and uses the JBE 5V power supply (see below). 2716 EPROM is available separately (not included in kit or assm. board). A 50 pin connector is included.

80-153 ASSM. **$110.95**
KIT **$ 89.95**
BARE BOARD **$ 24.95**

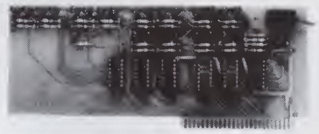
## APPLE II PARALLEL INTERFACE



JBE Apple II Parallel I/O Card interfaces printers, synthesizers, keyboards, and JBE A-D and D-A converter and solid state switches. This interface has handshaking logic, two 6522 VIAs and a 74LS74 for timing. Inputs and outputs are TTL compatible.

79-295 ASSM. **$69.95**
KIT **$59.95**
BARE BOARD **$22.95**

## APPLE II DISPLAY BOARD



This handy little (3x7") board is ideal for teaching and troubleshooting. It has a run — stop, single step switch which makes identification of shorted lines between address or data-bits easy and shows single steps for teaching computer logic. The display board has 16 Address LEDS, 8 Data LEDS & 1 RDY LED. All lines are buffered.

80-144 ASSM. **$49.95**
KIT **$42.95**
BARE BOARD **$25.95**

## SOLID STATE SWITCH

Control the world! Your computer can control power to your printer, lights, stereo and 120VAC appliances up to 720 watts (6 amps at 120VAC). Input 3 to 15VDC, 2-13 MA TTL compatible, isolation - 1500V, non zero crossing, the switch comes in a 1 or 4 channel version and includes documentation for interfacing with JBE Dimmer Control (see below). The 1 channel version is also available professionally packaged.

79-282 1 CHANNEL ASSM. **$13.95** KIT **$10.95** BARE BOARD **$ 6.95**
1 CHANNEL PKGD. **$39.95**
79-282 4 CHANNEL ASSM. **$49.95** KIT **$39.95** BARE BOARD **$24.95**

## BARE BOARDS

### APPLE II EXTENDER BOARD

This is what you've been waiting for! The 3½x2½" Apple II Extender Board makes troubleshooting much faster and easier! Great for use with the JBE Apple II Display Board. 50 pin Apple connector is included.

80-143 **$12.95**

### CRT CONTROLLER

This intelligent CRT Controller is completely contained on a 6x6½" printed circuit board. The design is based on an 8085A Microprocessor and an 8275 Integrated CRT Controller. It features the following:

- 25 Lines, 80 characters/line
- 5x7 Dot Matrix
- 8085 CPU
- Two 8185s
- Two 2716s (1 for software, 1 for user programmable character generator)
- Serial Interface RS232 and TTL
- Baud rates of 110, 150, 300, 600, 1200, 2400, 4800 & 9600.
- Keyboard Scanning System
- Uses +5V power supply and ±12V power supply (both available from JBE — see above)

**$39.95**

### 8085 3-CHIP SYSTEM

State-of-the-art system using 3 IC's, an 8085, an 8156 and either an 8355 or 8755. The system has the following:

- 3 MHz 8085 CPU
- 256 bytes static RAM
- 2048 bytes ROM
- 38 parallel input/output lines
- 2 serial input/output lines
- Instruction set 100% upward compatible with 8080A
14-bit counter/timer

**$24.95**

### 8088 5-CHIP SYSTEM

An 8086 Family microcomputer system using 5 IC's, an 8088 CPU, and 8284 clock generator, an 8155 RAM/IO/Timer, an 8755A EPROM/IO and an 8185 (1K x 8) Static RAM. This system has the following:

- 16-bit internal architecture
- Up to 1280 bytes of static RAM
- 2048 bytes of EPROM
- 38 parallel input/output lines
- 14-bit counter/timer
- Instruction set 100% compatible with the 8086

**$29.95**

## POWER SUPPLIES

### ± 12 VOLT POWER SUPPLY

This 2x2½" power supply uses a wall transformer for safety and is protected against short circuit and thermal breakdown. It is rated at ±12 V 120MA and can be used as a single 24V power supply at 120 MA. It is ideally suited to operational amplifier experiments.

80-161 ASSM. **$22.95**
KIT **$18.95**
BARE BOARD **$ 8.95**

### 5 VOLT POWER SUPPLY

This 2¼x2½" 5V 500MA power supply is protected against short circuit and thermal breakdown and uses a wall transformer for safety. It operates JBE A-D and D-A converter, 8085 computer, 8088 computer & 6502 micro-microcomputer. Documentation is included.

80-160 ASSM. **$20.95**
KIT **$16.95**
BARE BOARD **$ 8.95**

## DIMMER CONTROL

The JBE Dimmer Control has 4 channels, 256 brightness levels, on-board power supply and four 8-bit parallel input ports (not latched). This board interfaces with the JBE Solid State Switch and Apple II Parallel Interface Card (documentation included).

80-146 ASSM. **$89.95**
KIT **$79.95**
BARE BOARD **$25.95**

## SPARE PARTS

| INTEGRATED CIRCUITS | | CABLE | |
|---|---|---|---|
| 6502 | $ 9.95 | Standard Dip Jumpers | |
| 6522 | $ 9.95 | 16 Pin, 1 Ft. Length | $4.95 |
| 2716 5 Volt | $29.95 | **CONNECTORS** | |
| | | 50 Pin Connector | $5.95 |

# JOHN BELL ENGINEERING

99

VISA

*ALL PRODUCTS ARE AVAILABLE FROM:* **JOHN BELL ENGINEERING**
P.O. BOX 338 • REDWOOD CITY, CA 94064 • (415) 367-1137

MASTER CHARGE

*ADD 6% SALES* TAX IN CALIFORNIA. FOR ORDERS OUTSIDE THE U.S.A., ADD 5% FOR SHIPPING AND HANDLING.

Reader Service—see page 257

# Multi-Base Calculator

*Let your micro worry about number base conversions.*

*Hal Knippenberg*
*2514 Blueberry Drive*
*Augusta, GA 30906*

If you want to program microprocessors, you must learn to use several number bases. Leaf through any hobby computer magazine. Programs are written in octal, hexadecimal or split-octal, to name only a few of the common non-decimal number systems used today.

The problem comes when you start to program your own machine. You must not only be able to convert from one system to another, but you must also often perform simple arithmetic in any number base. Texas Instruments realized this when they introduced their TI Programmer/Calculator to aid people using different number bases.

The concept of a calculator that will work in any number base is excellent, but if you already own a personal computer, why not let it do the job for you?

I ran across a BASIC program (originally attributed to Benton Harbor) in a Digital Group Independent Users Group publication called *Bridge* that did the job reasonably well. The trouble with that program was it had several calculation errors in it, countless GOTO circles to follow and no remarks to help me figure out how it worked.

Still, I liked the idea of a multi-base calculator and decided to write a BASIC program of my own that would be easy to understand and modify, if required.

### Modified Program

The following styled program is the result of about two weeks of hair-pulling effort. You can see from the sample run that the program does what it should. It translates or computes in any of five number bases. This program is especially useful if you work in split-octal, since it removes all the hassle of keeping track of both page and byte numbers.

The program is written in Digital Group's Maxi-BASIC, which should translate easily to other personal computers using an extended BASIC. There are several things that may need explanation, however.

I used numerous REM statements to make the program self-documenting. But if you do not need documentation, you can eliminate all REM statements and the program will still work. Also, it is not necessary

*Program listing.*

```
100 REM  CALC          26 APRIL 79        HAL KNIPPENBERG
105 REM
110 REM  STYALIZED AND CORRECTED VERSION OF A PROGRAM LISTED IN
115 REM  'BRIDGE', VOL  1, NUMBER 2, WITH CHANGES IN VOL 1,
120 REM  NUMBERS 4, 5, AND 6
125 REM
130 REM  VARIABLES    A,I....INDEX COUNTERS
135 REM               B......VALUE OF BASE
140 REM               B1.....FLAGS BASE USED
145 REM               B$.....BASE NAME
150 REM               C......COUNTS DIGITS
155 REM               E......ERROR FLAG
160 REM               E$.....EXPRESSION TO BE CALCULATED
165 REM               H......DIGIT BEING CONVERTED
170 REM               H$.....PROCESSING RESULTS
175 REM               M......FLAGS OPERATION
180 REM               S......STORES ARITHMETIC RESULTS
185 REM               T......LAST NUMBER DECODED
190 REM               V......FIRST NUMBER DECODED
195 REM               X......PERTINENT POWER OF BASE
200 REM               X$.....TEMPORARILY HOLDS SUBSTRINGS
205 REM               Z......CALLS MACHINE LANGUAGE SUBROUTINE
210 REM
215                   DIM E$(40)
220                   DIM H$(18)
225 REM
230 REM * * * * * * * * * * * * * * * * * * * * * * * * * * *
235 REM         START MAIN ROUTINE
240 REM
245     Z=CALL(12762)                   :REM  CLEAR TV SCREEN
250 REM
255     #"             <<< MULTI-BASE CALCULATOR >>>"
260     #""
265     #"BASE DESIGNATORS:  T = DECIMAL    H = HEX    Q = OCTAL"
270     #"                   S = SPLIT-OCTAL    W = BINARY"
275     #" MATH OPERATIONS:  +, -, *, /"
280     #""
285     #"DIFFERENT BASES MAY BE MIXED IN THE SAME EXPRESSION."
290     #"BUT YOU MUST ENTER THE BASE DESIGNATOR FOR EACH "
295     #"NUMBER IF DIFFERENT FROM INITIAL ENTRY."
300     #"(SEPARATE SPLIT-OCTAL NUMBERS WITH A SPACE)"
305     #""
310     #"TO CHANGE BASE OF PREVIOUS ENTRY, ENTER DESIRED"
315     #"BASE DESIGNATOR ONLY.  ENTER 'OUT' TO END PROGRAM."
320     #""
325 REM
330     B=10                            :REM  INITIAL BASE
335 REM
340     M=0 :H$=""                      :REM  RESTART POINT
345 REM
```

to include all the spaces between a line number and the first character of a line statement. These spaces are used for clarity.

Line 245 may be deleted. I use a short machine-language subroutine to clear my TV screen prior to printing. If you have a CLEAR command, use it instead.

In Maxi-BASIC, substrings are handled very simply. For instance, if A$ is equal to "ABCDE" then A$(1,3) = "ABC" and A$(2,4) = "BCD". If only one number is contained in parentheses, then the string printed is from that number to the end of the string. In other words, A$(3) = "CDE" while A$(4) = "DE". If your BASIC uses LEFT$, RIGHT$ and MID$ to manipulate substrings, make the following changes:

Line 370 — E$(A,A) to MID$(A$,A,1)

Line 640 — H$(I,I) to MID$(H$,I,1)

Line 835 — H$(1,8) to LEFT$(H$,8) and H$(9) to RIGHT$(H$,8)

Line 855 — H$(1,3) to LEFT$(H,3) and H$(4) to RIGHT$(H$,3)

In Maxi-BASIC, # means PRINT, and a colon is used to separate multiple statements on the same line.

### Limitations

As handy as the Multi-Base Calculator program is, there are two things it will not do. When working in bases other than decimal, lines 685 and 735 limit the calculator program to numbers between 0 and 65535 (decimal) to stay within the range of the addressing capabilities of most microprocessors. Also, when dividing numbers other than decimal, the calculator program cannot print fractions. Instead, it prints only the integer result of the division.

Multi-Base Calculator is a handy tool for any serious-minded microprocessor programmer because it will allow the programmer time to think about the problem he is computing—not how to convert from one base to another. ■

```
             <<< MULTI-BASE CALCULATOR >>>
BASE DESIGNATORS   T = DECIMAL    H = HEX    Q = OCTAL
                   S = SPLIT-OCTAL   W = BINARY
 MATH OPERATIONS   +, -, *, /

DIFFERENT BASES MAY BE MIXED IN THE SAME EXPRESSION
BUT YOU MUST ENTER THE BASE DESIGNATOR FOR EACH
NUMBER IF DIFFERENT FROM INITIAL ENTRY
(SEPARATE SPLIT-OCTAL NUMBERS WITH A SPACE)
TO CHANGE BASE OF PREVIOUS ENTRY, ENTER DESIRED
BASE DESIGNATOR ONLY   ENTER 'OUT' TO END PROGRAM

  EXPRESSION   T1000=Q
                                          1750      OCT

  EXPRESSION   H
                                           3E8      HEX

  EXPRESSION   S
                                       003 350      OCS

  EXPRESSION   W
                             00000011 11101000      BNY

  EXPRESSION   Q101+17B3=S
 SORRY  I CAN'T HANDLE   Q101+17B3=S
  EXPRESSION   Q101+H17B3=S
                                       027 364      OCS

  EXPRESSION   H
                                          17F4      HEX

  EXPRESSION   S377 377=H
                                          FFFF      HEX

  EXPRESSION   Q
                                        177777      OCT

  EXPRESSION   S001 254*2=S
                                       003 130      OCS

  EXPRESSION:  T35-167=T
                                          -132      DEC

  EXPRESSION   H
 SORRY, I CAN'T HANDLE   H
  EXPRESSION:  OUT
```

*Sample run.*

```
350      INPUT"  EXPRESSION   ",E$
355      IF E$="OUT" THEN 880
360 REM
365      FOR A = 1 TO LEN(E$)
370         X$=E$(A,A)
375         IF X$="T" THEN B=10 :B1=1 :B$="DEC" :GOTO 460
380         IF X$="H" THEN B=16 :B1=2 :B$="HEX" :GOTO 460
385         IF X$="Q" THEN B= 8 :B1=3 :B$="OCT" :GOTO 460
390         IF X$="S" THEN B= 8 :B1=4 :B$="OCS" :GOTO 460
395         IF X$="W" THEN B= 2 :B1=5 :B$="BNY" :GOTO 460
400         IF X$="+" THEN M=1 :GOTO 540
405         IF X$="-" THEN M=2 :GOTO 540
410         IF X$="*" THEN M=3 :GOTO 540
415         IF X$="/" THEN M=4 :GOTO 540
420         IF B=8 THEN IF X$=" " THEN 455
425         IF B=2 THEN IF X$=" " THEN 460
430         IF X$="=" THEN V=T :GOTO 540
435         IF X$<"0" THEN 565
440         IF X$>"F" THEN 565
445         IF X$<="9" THEN 455
450         IF X$<"A" THEN 565
455         H$=H$+X$
460      NEXT A
465 REM
470      IF M=1 THEN T=V+T
475      IF M=2 THEN T=V-T
480      IF M=3 THEN T=V*T
485      IF M=4 THEN T=V/T
490      S=T                             :REM  SAVE RESULTS
495 REM
500      GOSUB 730                       :REM  CHANGE DEC. TO BASE
505      IF E=1 THEN 565
510 REM
515      #TAB(50-LEN(H$)),H$,B$          :REM  PRINT RESULTS
520      #""
525 REM
530      T=S :GOTO 340                   :REM  GET NEXT EXPRESSION
535 REM
540      GOSUB 615                       :REM  CHANGE BASE TO DEC.
545      IF E=1 THEN 565
550 REM
555      H$="" :GOTO 460                 :REM  CONTINUE DECODING
560 REM
565      #""                             :REM  ERROR MESSAGE
570      #"SORRY, I CAN'T HANDLE   ";E$
575      #""
580      E=0 :GOTO 340                   :REM  TRY AGAIN
585 REM
590 REM - - - - - - - - - - - - - - - - - - - - - - - - - - -
595 REM   SUBROUTINE   BASE TO DECIMAL CONVERSION
600 REM      IN:  B, H$
605 REM     OUT   T
610 REM
615      IF B=10 THEN T=VAL(H$) :GOTO 690
620      T=0 :E=0 :X=1 :C=0
625      FOR I=LEN(H$) TO 1 STEP -1
630         C=C+1                        :REM  COUNTS DIGITS
635 REM
640         H=ASC(H$(I,I))-48            :REM  CHANGE ASCII TO
645         IF H>9 THEN H=H-7            :REM   A NUMBER
650 REM
655         IF H = -16 THEN X=256 :GOTO 680
660         IF (H<0 OR H>(B-1)) THEN E=1
665         IF B1=4 THEN IF(C=3 OR C=7) THEN IF H>3 THEN E=1
670         T=T+(H*X)
675         X=X*B
680      NEXT I
685      IF (T<0 OR T>65535) THEN E=1
690      RETURN
695 REM
700 REM - - - - - - - - - - - - - - - - - - - - - - - - - - -
705 REM   SUBROUTINE   DECIMAL TO BASE CONVERSION
710 REM      IN   B, T
715 REM     OUT   H$
720 REM
725      H$="" :E=0
730      IF B=10 THEN H$=STR$(T) :GOTO 865
735      IF(T<0 OR T>65535) THEN E=1 :GOTO 865
740      IF B=16 THEN X=4096 ELSE X=32768
745      IF B1=4 THEN X=16384
750      H=INT(T/X)
755      T=T-(H*X)
760      IF H$="" THEN IF H=0 THEN 790
765 REM
770      H=H+48                          :REM  CHANGE NUMBER TO
775      IF H>57 THEN H=H+7              :REM   ASCII
780 REM
785      H$=H$+CHR$(H)
790      X=X/B
795      IF X<1 THEN 825
800      IF B1=4 THEN IF X=32 THEN X=64
805      GOTO 750
810 REM
815 REM   FORMAT THE OUTPUT
820 REM
825      IF B<>2 THEN 845
830        IF LEN(H$)<16 THEN H$="0"+H$ :GOTO 830
835        H$=H$(1,8)+" "+H$(9)
840 REM
845      IF B1<>4 THEN 865
850        IF LEN(H$)<6 THEN H$="0"+H$ :GOTO 850
855        H$=H$(1,3)+" "+H$(4)
860 REM
865      RETURN
870 REM
875 REM - - - - - - - - - - - - - - - - - - - - - - - - - - -
880                              END
READY
```

✓Reader Service—see page 257

# From Zip to Zone

*A little subroutine that can save businesses a lot of time.*

*William Klungle*
*1820 W. Lakewood*
*Holland, MI 49423*

Several years ago I added a "little" subprogram to the order entry system of my company's invoicing department. Just as the song says, "little things mean a lot," this subprogram saves time and spares valuable personnel the drudgery of a repetitious, monotonous task.

The subprogram is a very simple test routine that will convert the zip code entered on your work-order, shipper and invoice forms to the UPS or parcel post shipping zone number.

If you happen to live in Michigan, you can use this subprogram just as it is listed here (see Listing 1). If you live elsewhere, you will have to match the zip-code breaks to the zones as they apply to your location. Unfortunately, the zip-to-zone postal charts don't seem to have any logical pattern so the most difficult part of programming this routine is the time it will take to enter and check all of the zip-code number groups necessary to determine the various zones.

This subprogram was originally written for a Hewlett-Packard HP-3000, and was later converted for an HP-250. This same routine has been programmed on the Radio Shack TRS-80 Model I. Since the BASIC commands used are from the universal BASIC programming language, the routine may be used with any version of BASIC.

### Exploring the Subprogram

The subprogram comprises a series of tests that use the numeric equivalent of the first three positions of a zip code to determine the proper shipping zone. The string variable Z$ is set with the zone number as a result of the tests. Before the subprogram is called, you must set a numeric variable (Z1) to the value of the first three positions of the zip code. Depending upon the commands available in your version of BASIC, there will be numerous ways to do this.

*Listing 1. Zip to zone subroutine.*

```
1000 REM:  ZIP TO ZONE SUB-ROUTINE
1010 REM:  TRS-80 LEVEL II VERSION  by WILLIAM KLUNGLE
1020 REM:  VALID FOR THE STATE OF MICHIGAN
1030 REM:  Z$ = ZONE NUMBER     Z1 = FIRST 3 ZIP NUMBERS
1040 REM:
1050 Z$=""
1060 IF Z1 > 5 AND Z1 < 9 THEN Z$=" 8"
1070 IF Z1 > 9 AND Z1 < 398 THEN Z$=" 4"
1080 IF Z1 = 77 THEN Z$=" 5"
1090 IF Z1 > 86 AND Z1 < 120 THEN Z$=" 5"
1100 IF Z1 = 109 THEN Z$=" 4"
1110 IF Z1 > 123 AND Z1 < 127 THEN Z$=" 5"
1120 IF Z1 = 129 THEN Z$=" 5"
1130 IF Z1 = 161 THEN Z$=" 3"
1140 IF Z1 > 163 AND Z1 < 166 THEN Z$=" 3"
1150 IF Z1 > 232 AND Z1 < 238 THEN Z$=" 5"
1160 IF Z1 > 259 AND Z1 < 262 THEN Z$=" 3"
1170 IF Z1 > 277 AND Z1 < 280 THEN Z$=" 5"
1180 IF Z1 > 282 AND Z1 < 286 THEN Z$=" 5"
1190 IF Z1 > 289 AND Z1 < 359 THEN Z$=" 5"
1200 IF Z1 = 293 THEN Z$=" 4"
1210 IF Z1 > 295 AND Z1 < 298 THEN Z$=" 4"
1220 IF Z1 = 305 THEN Z$=" 4"
1230 IF Z1 = 307 THEN Z$=" 4"
1240 IF Z1 > 328 AND Z1 < 340 THEN Z$=" 6"
1250 IF Z1 > 355 AND Z1 < 428 THEN Z$=" 4"
1260 IF Z1 > 359 AND Z1 < 370 THEN Z$=" 5"
1270 IF Z1 = 387 THEN Z$=" 5"
1280 IF Z1 > 388 AND Z1 < 400 THEN Z$=" 5"
1290 IF Z1 > 399 AND Z1 < 403 THEN Z$=" 3"
1300 IF Z1 = 410 THEN Z$=" 3"
1310 IF Z1 > 427 AND Z1 < 548 THEN Z$=" 3"
1320 IF Z1 > 433 AND Z1 < 437 THEN Z$=" 2"
1330 IF Z1 = 458 THEN Z$=" 2"
1340 IF Z1 > 461 AND Z1 < 469 THEN Z$=" 2"
1350 IF Z1 > 475 AND Z1 < 478 THEN Z$=" 4"
1360 IF Z1 > 479 AND Z1 < 497 THEN Z$=" 2"
1370 IF Z1 > 499 AND Z1 < 517 THEN Z$=" 4"
```

```
1380 IF Z1 = 525 THEN Z$=" 4"
1390 IF Z1 > 528 AND Z1 < 535 THEN Z$=" 2"
1400 IF Z1 = 540 THEN Z$=" 4"
1410 IF Z1 > 547 AND Z1 < 688 THEN Z$=" 4"
1420 IF Z1 = 549 THEN Z$=" 3"
1430 IF Z1 = 567 THEN Z$=" 5"
1440 IF Z1 > 572 AND Z1 < 580 THEN Z$=" 5"
1450 IF Z1 > 581 AND Z1 < 590 THEN Z$=" 5"
1460 IF Z1 > 589 AND Z1 < 599 THEN Z$=" 6"
1470 IF Z1 = 599 THEN Z$=" 7"
1480 IF Z1 > 599 AND Z1 < 610 THEN Z$=" 2"
1490 IF Z1 > 609 AND Z1 < 620 THEN Z$=" 3"
1500 IF Z1 > 623 AND Z1 < 628 THEN Z$=" 3"
1510 IF Z1 > 667 AND Z1 < 680 THEN Z$=" 5"
1520 IF Z1 > 687 AND Z1 < 828 THEN Z$=" 5"
1530 IF Z1 > 722 AND Z1 < 727 THEN Z$=" 4"
1540 IF Z1 > 767 AND Z1 < 776 THEN Z$=" 6"
1550 IF Z1 = 773 THEN Z$=" 5"
1560 IF Z1 > 778 AND Z1 < 790 THEN Z$=" 6"
1570 IF Z1 > 792 AND Z1 < 800 THEN Z$=" 6"
1580 IF Z1 > 803 AND Z1 < 806 THEN Z$=" 6"
1590 IF Z1 > 807 AND Z1 < 820 THEN Z$=" 6"
1600 IF Z1 > 822 AND Z1 < 885 THEN Z$=" 6"
1610 IF Z1 = 827 THEN Z$=" 5"
1620 IF Z1 = 833 THEN Z$=" 7"
1630 IF Z1 > 834 AND Z1 < 839 THEN Z$=" 7"
1640 IF Z1 > 849 AND Z1 < 865 THEN Z$=" 7"
1650 IF Z1 > 884 AND Z1 < 900 THEN Z$=" 7"
1660 IF Z1 = 899 THEN Z$=" 8"
1670 IF Z1 > 921 AND Z1 < 926 THEN Z$=" 7"
1680 IF Z1 = 935 THEN Z$=" 7"
1690 IF Z1 = 961 THEN Z$=" 7"
1700 IF Z1 > 976 AND Z1 < 985 THEN Z$=" 7"
1710 IF Z1 > 986 AND Z1 < 995 THEN Z$=" 7"
1720 RETURN
```

```
1 REM:    LISTING NUMBER  2
2 REM:
10 REM:  TEST PROGRAM FOR ZIP TO ZONE SUB-ROUTINE
20 REM:  FOR TRS-80, LEVEL II  by WILLIAM KLUNGLE
30 REM:
40 CLS
50 INPUT "ZIP CODE : ";Z2
60 Z1 = INT(Z2/100)
70 GOSUB 1000
80 PRINT TAB(30);CHR$(27);"SHIPPING ZONE = ";Z$
90 GOTO50
```

*Listing 2. Test program for zip to zone subroutine.*

For example, many BASICs incorporate a command that will let a string variable be separated into segments. The command Z1$ = LEFT$(ZC$,3) will fill the string variable Z1$ with the first three characters of the variable ZC$, which contains the zip code. Z1$ must now be converted to the numeric variable Z1, and the subprogram may be called to determine the shipping zone.

If the zip code is contained in a numeric variable such as Z2, this variable can be divided by 100. The integer portion of the variable is then sent to the subprogram to determine the shipping zone, as in Z1 = INT(Z2/100).

With the numeric variable Z1 set to the value of the first three positions of the zip code, the subprogram is called. First the subroutine sets the zone variable Z$ to a null string. The program then tests variable Z1 against the known zip-code groups. When a match is found, Z$ is set to the proper zone number.

Notice that although a particular number may pass several of the tests, at the end of the test sequence the variable Z$ will contain the proper zone for the zip code entered. If an erroneous zip code is sent to the subroutine, variable Z$ will return as a null string. This return may be used by the program to alert the operator that an incorrect zip code has been entered.

Before appending this subprogram to your programs, use the test program shown in Listing 2 to ensure that the IF tests have been typed in correctly. With a subroutine of this type it is very easy to transpose a group of numbers in one or more of the test lines. In the original version of this routine, I entered one of the test groups incorrectly and the error went undetected for over a year.

This simple subprogram has proven itself to be a valuable time-saver. If you have a similar need, this routine will be well worth the time it may take to append it to your programs. ■

✓ Reader Service—see page 257

# Apple II Plus Plus

*The early bird gets the worm and the Apple.*

*John W. Davison*
*PO Box 1165*
*Ft. Walton Beach, FL 32549*

If you bought an Apple II prior to the Plus version and have an Applesoft ROM card, you can easily upgrade your system to exceed the capabilities of the current version of the Apple II Plus. The only cash outlay is $65 for the Auto-Start ROM package (part no. A2M0027).

The features of the Auto-Start ROM (and the Apple II Plus) are as follows. They go directly into BASIC at power-on, they automatically boot the disk drive at power-on, they return to BASIC instead of the monitor when the reset key is pressed, they have four additional cursor movement controls for fast editing, and they have a stop-list function that lets you stop a program listing at any point and resume it at will.

But you give up a few things when you replace the old monitor ROM with an Auto-Start ROM. You no longer have instant access to the monitor by pressing the reset key, access to the Sweet-16 interpreter or access to the miniassembler, and you lose the step and trace monitor functions.

You can keep the features of both (except for access to the monitor by pressing the reset key) by inserting the old monitor ROM into the F8 socket on the Applesoft ROM card after installing the Auto-Start ROM in the F8 socket on the motherboard.

First, activate the Applesoft card (with FP, if the DOS is booted or is reset with the switch on the ROM card in the on position). Then enter the monitor with a CALL −151. Everything will be as it was, with the addition of the extra cursor controls and stop-list function. Press the reset key, and you will return to BASIC with all assembly and BASIC programs and the DOS intact.

You can also have Applesoft BASIC as the power-up language with Integer BASIC the secondary language, as in the Apple II Plus. Simply exchange the ROM ICs in sockets F0, E8, E0, D8 and D0 on the motherboard, with the ROM ICs in the corresponding sockets on the ROM card. That's all there is to it. To use the old monitor, invoke Integer BASIC first (it is still initialized by INT with the DOS booted even though it is on the ROM card now). Then proceed as before.

You must not get the two sets of ROMs mixed up or in the wrong sockets. The pins on the ROMs are very easy to bend, so any changing should be done by someone who knows how to do it. Even if you will never do any programming in assembly language, what's wrong with a little one-upmanship?■

Reader Service—see page 257

# Programming Heath's USART

## *Eliminate input/output problems.*

*D. C. Shoemaker*
*2000 A Foxridge*
*Blacksburg, VA 24060*

If your computer uses a serial device such as a printer or a CRT terminal, it will probably be a universal synchronous-asynchronous receiver-transmitter (USART). As long as you run prepared software packages created for your system, you will have no input/output problems. The software will handle the I/O for you either through device drivers included with the software, or by means of a resident ROM monitor.

But eventually many of us are drawn to the challenge of assembly-language programming, and the problem of communication between computer and terminal arises. If your computer's I/O routines reside in the ROM monitor the problem is reduced to one of initializing the desired USART for the intended output port or ports.

For the Heath system, two serial interface boards are available. One incorporates the tape interface and a single serial port, and the other contains four serial ports without the cassette interface. The USART the latter uses is more challenging to program, because of the wider choice of options available. This USART, the INS8250, is common in the micro field, and even if you're a non-Heath user, you might be able to use some of this information.

The 8250 is a seven-port device, which accounts for its versatility and usefulness. It has many programmable features, but for the moment our goal will be to initialize the USART so the computer can perform I/O functions. This can be done using the short routine in Program A. (This routine uses split octal notation because the front panel of my H-8 uses that form, but most assemblers will take either hex, decimal or split octal.)

The first part of the routine establishes the baud rate divisor and a table of EQUates to facilitate changing the baud rate as your programming needs change. An alteration merely requires an EQU change. We also identify the base port address, which can be located nearly anywhere you like, with the other six port addresses simply incremented by one.

Next comes the baud rate selection. This will require sending the DATA Latch Access Bit (DLAB) to 1. We also establish the word length (in this case, for an 8-bit word). Setting the baud rate is accomplished by setting the least significant byte of the baud rate divisor to address 0 and the most significant byte to address 1 while the DLAB is still set. (We'll change it later.)

Once the baud rate is set, the DLAB will have to be reset to 0 again, because the register at address 0 is also the data register. We send a 3 (003 in octal) to PORT +3, so we can continue to use 8-bit words.

One last detail: register A must be cleared by means of an XRA A instruction, and an O must be sent to PORT + 1 to disable the interrupts. This is required because of the polling used by the USART.

That's all there is to it. By using a similar routine, you can initialize your 8250 to communicate with your terminal, printer or any other serial device you wish. Be sure to check the addresses of your own system. The data sheet for the INS8250 gives all the register addresses and bit numbers, useful for more sophisticated applications, but this short introduction should be enough to set you "on the air."

The Heath Assembly Language Programming Course, written by Willard Nico, should be credited as the source of most of this information. If you use an 8080 or 8085 processor, I strongly recommend the course as an entry-level tutorial. It is not Heath-specific, but applicable to any 8080/8085 system. ■

```
*  INITIALIZE THE 8250 USART
*
B75     EQU     1536            *BAUD RATE DIVISORS IN DECIMAL
B110    EQU     1047
B134    EQU     857
B300    EQU     384
B600    EQU     192
B1200   EQU     96
B2400   EQU     48
B4800   EQU     24
B9600   EQU     12
B19200  EQU     6
*
PORT    EQU     060Q            *SELECTED BASE PORT ADDRESS
BAUD    EQU     B1200           *BAUD RATE DIVISOR (EXAMPLE)
*
* FOLLOWING IS THE INITIALIZATION ROUTINE PROPER
*
INIT    MVI     A,203Q          *SET THE DLAB IN REGISTER A
        OUT     PORT+3          *SEND TO THE 4TH PORT
        MVI     A,#BAUD         *BAUD RATE (LEAST SIGNIFICANT VALUE)
        OUT     PORT            *SEND TO THE 1ST PORT
        MVI     A,BAUD/256      *BAUD RATE (MOST SIGNIFICANT VALUE)
        OUT     PORT+1          *SEND TO THE 2ND PORT
        MVI     A,003Q          *SET FOR 8-BIT WORD; RESET DLAB
        OUT     PORT+3          *SEND TO THE 4TH PORT
        XRA     A               *CLEAR A (DISABLE INTERRUPTS)
        OUT     PORT+1          *AND SEND TO THE 2ND PORT
        RET                     *END OF INITIALIZATION
```

*Program A. Initialization routine for the 8250.*

# Give Character to Your PET Printer

*Creating user-defined characters on the 2022 and 2023 printers.*

*Neil Piper*
*VA Medical Center*
*East Orange, NJ 07019*

The use of PEEK and POKE to manipulate the video display memory by using the numeric keypad as a direction controller for a cursor and roving ball is an interesting alternative to the "normal" print statement-controlled cursor movement and printing (see PET-pourri, Feb. 1979).

To see what I could learn about the video display and PEEK/POKE statements, I set about playing with and manipulating this program. It was a nice game, but not until we acquired a Commodore 2023 "smart" printer did I put variations of this program to real use.

Another PET-pourri column (Dec. 1979) included a review of the CBM printers and a small program to display user-defined characters and print-enhancement. At our hearing research lab, we have used the printer for hard copies of patient responses, formatted lists of data and lengthy hard copies of detailed conversion tables used in data analysis.

We also wanted to use the printer to create graphs and tables listing the International Phonetic Alphabet (IPA). This alphabet is a set of symbols representing distinct sounds of speech. Many of the symbols are lowercase letters of the English alphabet, but others are Greek or hybrids of different alphabets. The programmed-character capability was ideal.

But "tedium" became the catchword of the day when I sat down to program IPA symbols. I spent a whole workday of endless erasing, countless computations and a ceaseless series of diagrams and doodles to program 15 characters.

### Creating the Character

The Commodore printers have a 6×7 font, so the first step is to draw a 6×7 cell matrix. The character is laid out by drawing dots, circles or whatever you like within the appropriate squares.

The numerical value of each matrix column is then computed for later program insertion. The seven horizontal rows are designated as powers of two, the bottom row designated as $2^0$ and the top row designated as $2^6$. Each vertical column is totaled for the decimal value of the binary number represented by the dots within the column.

An example is given in Fig. 1. Notice that in the first column there are no dots; the total is zero. In the second column, there are dots in the "$2^6$" and "$2^4$" rows; the total is 80 (64 plus 16).

After all the columns have been computed, they are entered into a data statement. A FOR loop routine accumulates the six "character" representations of the six numbers into one string variable, which in turn is stored in the printer memory for later call-up as the user-defined character.

Creating a set of characters can be tedious when many are required. I decided that there must be a better and easier way to create the characters, so I set out to write a program to create the characters.

I now have a program that displays a 6×7 cell matrix on the PET CRT, provides a movable cursor which won't go outside the borders of the matrix, calculates the decimal values of each column and prints the character along with the column values on the printer. It is based on variations of the PET-pourri theme mentioned before.

### The Program

The first part of the program sets printer formatting and readies it to accept "programmed" characters. Line 240 provides the formatting information. A tells the printer to accept and print an alpha character, and the Zs tell the printer to accept right-justified numerals within the specified columns, placing leading zeros in blank spaces.

Line 250 places the format information into the printer memory. Lines 300–350 initialize the variables used to control the movement of the matrix cursor and dimension the

Program listing.

```
1 REM * * * * * * * * * * * * * * * * * * *
2 REM * * PET  PRINTER WITH CHARACTER * *
4 REM * *       BY NEIL PIPER       * *
6 REM * * * * * * * * * * * * * * * * * * *
100 REM ************************
101 REM ** OPEN PRINTER FILES **
102 REM ************************
103 REM
110 OPEN1,4,1:REM USE FOR FORMATTED PRINT
120 OPEN2,4,2:REM SETS FORMATTING
130 OPEN3,4:REM GENERAL PRINT FILE
140 OPEN4,4,5:REM SET USER DEFINED CHAR
150 REM
200 REM ************************
210 REM ** SET PRINTER FORMAT **
220 REM ************************
225 REM
230 REM
240 SET$="   A     ZZZ   ZZZ   ZZZ   ZZZ   ZZZ   ZZZ"
245 REM
250 PRINT#2,SET$
260 REM
300 REM *************************
301 REM **INITIALIZE VARIABLES **
302 REM *************************
303 REM
310 DIM CHAR(5,50), CAR$(50)
320 REM
330 BEGIN=32900:LAST=BEGIN:R=120:C=4
340 BLANK=32:SPOT=81:CRSR=100
350 ROW=BEGIN:COL=0:LROW=ROW:LCOL=COL
370 REM
400 REM **************************
410 REM ** PRINT CHARACTER FONT **
420 REM **************************
430 REM
440 GOSUB 10000:POKE BEGIN,CRSR: REM PRINTS BOX WITH CRSR
450 REM
470 REM
500 REM ******************************
510 REM ** KEYBOARD NUMBER & GOSUB **
520 REM ******************************
530 REM
540 GET KEY$:IF KEY$="" GOTO 540
550 IF KEY$=CHR$(13) GOTO 700
560 IF KEY$="Q" THEN POKE LAST,SPOT: GOTO 540
570 IF VAL(KEY$)=0 OR VAL(KEY$)=5 GOTO 540
580 ON VAL(KEY$) GOSUB 1000,2000,3000,4000,,6000,7000,8000,9000
590 TEST=ROW+COL
595 REM
600 REM ******************
601 REM ** CHECK BORDERS **
602 REM ******************
603 REM
610 IF TEST<BEGIN OR TEST>BEGIN+740 GOTO 660
620 IF TEST=>ROW AND TEST<=ROW+20 THEN NEX=TEST: GOTO 640
630 GOTO 660
640 IF PEEK(LAST)<>SPOT THEN POKE LAST,BLANK
650 POKE NEX,CRSR: LAST=NEX: LROW=ROW: LCOL=COL: GOTO 540
660 ROW=LROW:COL=LCOL: GOTO 540
670 REM
700 REM **************************
701 REM ** COMPUTE CHAR & STORE **
702 REM **************************
703 REM
710 FOR S=0 TO 6: FOR T=0 TO 5
715 SQUARE=BEGIN+(R*S)+(C*T)
720 IF PEEK(SQUARE)<>SPOT GOTO 730
725 CHAR(T,N)=CHAR(T,N)+2↑(6-S)
730 NEXT T: NEXT S
735 FOR A=0 TO 5:CAR$(N)=CAR$(N)+CHR$(CHAR(A,N)): NEXT A
740 REM
745 PRINT "?ANYMORE?": GOSUB 20000
750 IF AN$="Y" THEN N=N+1: GOTO 330
755 FOR A=0 TO N: PRINT#4,CAR$(A): PRINT#1, CHR$(254),CHR$(29);
760 FOR B=0 TO 5: PRINT#1, CHAR(B,A);: NEXT B: PRINT#3
765 NEXT A: PRINT#3,CHR$(13): PRINT#3
770 CLOSE 1: CLOSE 2: CLOSE 3: CLOSE 4
775 END
900 REM
901 REM**********************
902 REM** SETS COL AND ROW **
998 REM**********************
999 REM
1000 COL=LCOL-C:ROW=LROW+R:RETURN
2000 ROW=LROW+R:RETURN
3000 COL=LCOL+C:ROW=LROW+R:RETURN
4000 COL=LCOL-C:RETURN
6000 COL=LCOL+C:RETURN
7000 COL=LCOL-C:ROW=LROW-R:RETURN
8000 ROW=LROW-R:RETURN
9000 COL=LCOL+C:ROW=LROW-R:RETURN
9900 REM
10000 REM***************
10001 REM *** MATRIX ***
10002 REM***************
10005 A$(1)="|   ":A$(2)=A$(1):A$(3)="|___"
10010 PRINT"??"SPC(10):FORA=1 TO 25:PRINT "_";:NEXT A: PRINT
10015 FOR A=1 TO 7
10020 FOR B=1 TO 3: PRINT SPC(10);
10025 FOR D=1 TO 6
10030 PRINT A$(B);:NEXT D:PRINT "|"
10035 NEXT B
10040 NEXT A
10050 RETURN
10060 REM
20000 REM****************
20001 REM** GET ANSWER **
20002 REM****************
20003 REM
20010 GET AN$: IF AN$="" GOTO 20010
20020 AN$=LEFT$(AN$,1)
20030 IF AN$="Y" OR AN$="N" THEN RETURN
20040 PRINT "??": GOTO 20010
```

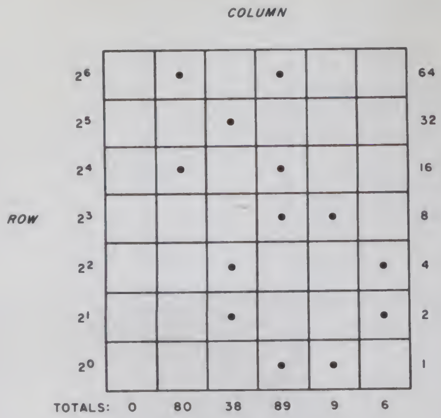



*Fig. 1. A user-defined character.*

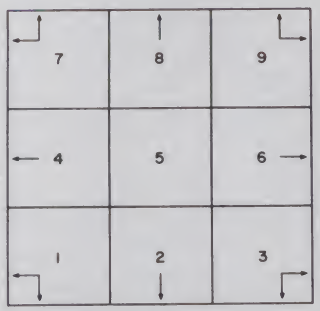



*Fig. 2. Keypad direction control.*

character arrays for storage and printing.

Notice that LROW and ROW are used. The first contains the value of the "last" row in which the cursor resided; the second contains the new row position. Ditto for LCOL and COL. If the new values of ROW and COL exceed specified limits, the "new" values revert back to the "last" values.

Line 440 calls up the PRINT MATRIX subroutine and, after the matrix is displayed, places the cursor in the top left cell (video display address 32900—variable BEGIN). This location places the matrix at about center screen, and is a nice easy number to work with (the video display ranges from 32768 to 33767). The center of each matrix cell is the target address for the PEEKs and POKEs used to position and place the cursor and SPOTs.

The GET function monitors the numeric keypad for cursor direction and movement according to the layout in Fig. 2. If [RETURN] is hit [CHR$(13)], the COMPUTE subroutine is called up to figure the column values and store them and the character in respective arrays. If a digit is hit, the cursor is moved accordingly—corner digits will increment or decrement both row and column variables. 8 and 2 will increment or decrement only ROW, and 4 and 6 will do likewise only to COL.

The variable TEST compares the sum of ROW and COL with the border limits of the matrix in lines 610–660. Upper and lower border limits consist of the max/min values of the matrix—BEGIN to BEGIN plus 740. ROW will always be a multiple of 120 plus BEGIN, so side borders will always fall between the left cell value for a particular row to 20 more than this value.

In all cases, if a conditional test is met, the "new" row and column values take on the "last" row and column values, and the cursor remains stationary (line 660).

Computation of matrix values uses a nested FOR loop to scan the cells vertically within columns by peeking the appropriate addresses for SPOT (decimal value 81). If it appears, the loop values are used to compute and accumulate the value of each column. Column totals are stored in an array and called up in line 735 to form the programmed character. The character, in turn, is stored in a string array for later printing.

Lines 755–765 print each character and set of values according to the previously stored format. Note that CHR$(29) is the instruction required by the printer to move to the next formatted column after the formatted string has been printed.

### Programming Comments

In line 580, two comma delimiters are listed after 4000. These are used to make the computer think that a line exists for digit 5 so that digit-subroutine correspondence remains correct.

Also, notice that the MATRIX subroutine prints the matrix by using concatenated strings within nested FOR loops. I could have just as easily graphed out the matrix on the CRT and stored it as a series of print statements that would perform the same function, but doing that tends to use up a lot more memory.

If you want to move the matrix around, or change the size of it, you'll have to figure out the new video display addresses for the cursor targets. I don't suggest it; the present matrix is the largest that fits on the PET screen while retaining approximate proportions of the character font as well as maintaining usable spacing for cursor manipulation.

If you do attempt size modifications, remember that the video display consists of 25 40-column lines.

If you want to print headings above the character and values columns, you can modify the SET$ variable to accommodate more alpha characters where A is, and change the Zs to As; or, just program a string that the printer will print before the characters are output (use PRINT#3, . . .). To satisfy anyone's curiosity, an example of some programmed IPA symbols can be seen in Fig. 3.

### Final Remarks

In a nutshell, this program takes the tedious, time-consuming work out of creating user-defined characters on the Commodore 2023 or 2022 printers. It's fast, just about foolproof, and fun to run. And if you fall into the same category as I do—a curious, eager-to-learn computer enthusiast—I think you will find the program a good exercise in using PEEK, POKE and the video display memory and in utilizing your printer in diverse ways.

I think you can also see that offshoots of this program can probably be adapted for user port control of a light pen, rather than keypad control, to do the same thing.■

| | | | | | | |
|---|---|---|---|---|---|---|
| ð | 000 | 080 | 038 | 089 | 009 | 006 |
| ʃ | 000 | 000 | 049 | 073 | 070 | 000 |
| θ | 000 | 062 | 073 | 073 | 062 | 000 |
| a | 006 | 041 | 041 | 041 | 030 | 001 |
| ɪ | 000 | 017 | 031 | 017 | 000 | 000 |
| ʧ | 016 | 062 | 016 | 057 | 070 | 000 |
| ə | 006 | 037 | 037 | 021 | 014 | 000 |
| ʒ | 000 | 004 | 114 | 018 | 012 | 000 |
| æ | 038 | 041 | 030 | 028 | 042 | 025 |

*Fig. 3. User-defined IPA and associated values.*

# Poor Man's Floppy

HIGH SPEED CASSETTE SYSTEM


## FOR TRS-80*

***Now the widely acclaimed JPC Cassette System is available for your TRS-80* computer. The price is only $90.00***

[Reprint of June 1980 Review, *80 Microcomputing*]

**TC-8 Cassette System**
**JPC Products**
**Albuquerque, NM**
**Kit: $90**
**Assembled: $120**

**by Carl A. Kollar**

I guess I don't have to tell any TRS-80 owners how frustrating the cassette system that comes with the computer can be. Even with the factory mod that's available, the annoyance of loading and checking programs becomes just barely tolerable.

If you're like me, after you've just plunked down a chunk of money for a Level II 16K machine, "you ain't got nuttin left" for even one disk drive at 500 bucks apiece. So you suffer.

A reasonable alternative is the Exatron Stringy Floppy (ESF). This will cost you about 250 bucks and totally eliminates your loading and saving problems, automatically and fast. I've had one of these for about six months and love it!

But, if the price is still too steep, have I got a device for you!

**The Device**

The February 1980 issue of *Microcomputing* had an ad that intrigued the hell out of me. It was a high-speed cassette system by JPC Products acclaimed as a "poor man's floppy." It made all sorts of seemingly ridiculous claims such as "loads five times faster," "stores 50,000 bytes on a 10-minute cassette," "less than one bad load in a million bytes with the volume control anywhere between one and eight."

All this for a measly [90] bucks? How could this be? A call to Albuquerque answered a few questions: Yes, it had its own power supply, and, it stored programs five times faster because it utilized higher density data. The computer outputs the information at a higher rate out of the rear keyboard connector.

The ad had even claimed anyone could build it even if you have never soldered before. JPC would make it work, if you couldn't—for free. I was sold. I placed my order, and it arrived about two months later (parts shortage).

I work in electronics, so I found the unit exceptionally easy to build. *It took about an* hour. The manual is superb. (That's better than great.) It was clear, concise and exact with no ambiguities. Important parts placements are stressed (polarity markings on electrolytics, bands on diodes, etc.).

JPC was right! With these instructions, you couldn't go wrong. The board quality is excellent. It is double-sided and parts locations are clearly marked on the component side of the board. There are no jumper wires to install. JPC utilizes PC traces and plated-through holes for connections to traces on the other side of the board.

Also, there are absolutely no adjustments or settings to bother with.

The documentation is a sheaf of 8½ × 11 papers stapled together. It is written in the nicest format I've seen in a while. Each command and/or subjects is covered on its own sheet in large type. All explanations are in easy to read English—not computerese.

**Commands and Features**

**SAVE"filename":** Saves your BASIC program on cassette.
**LOAD:** Reads the next BASIC program from the cassette.
**LOAD"filename":** Searches for and loads the specified file from cassette.
**LOAD? and LOAD?"filename":** Reads file from cassette, and compares contents to memory.
**LOADN:** Prints a list of all the programs on a cassette, until interrupted by the "break" key.
**LOADN"filename":** Same as above except the tape will stop at the end of the program named.
**KILL:** Removes the file manager program from memory so that the extra memory can be used by large programs.
**RSET:** Allows the operator to rewind and position the tape on tape recorders that have these functions tied to the motor control jack.
**RUN"filename":** TC-8 searches for a specified program and runs it immediately.
**PUT"filename":** Same as SAVE "filename", except it is for use with system tapes.
**GET:** Same as LOAD, except it is for use with system tapes.
**GET"filename":** Same as LOAD "filename", except it is for use with system tapes.
**GET? and GET?"filename":** Same as LOAD? and LOAD?"filename", except it is for use with system tapes.
**GETN and GETN"filename":** Same as LOADN and LOADN"filename", except it is for use with system tapes.
**OPEN:** Required before cassette input or output of a data file can be attempted.
**CLOSE:** Required to end a cassette data file.
**PRINT#:** Allows numerical or string data to be output to a cassette file.
**INPUT#:** Allows numerical or string data to be input from a cassette file.

I haven't counted them, so I don't know about the "one load in a million bytes" claim, but my son, Anthony (age 11), loaded about 30 of his programs from his Radio Shack format tape to a new TC-8 format tape. He's run them all and found no bad loads.

Unlike the standard tape system, you can position your tape anywhere before the program you want and not have to look for a blank spot between programs. The TC-8 patiently waits for the program you want and then starts loading without getting confused by the portion of the previous program you just fed it.

Try that on your regular cassette system; you'll wear out the reset button. ■

**ORDER NOW**

To order your TC-8 kit, send your check or money order for $90.00 plus $3.50 postage and handling to JPC PRODUCTS CO., 12021 Paisano Ct., Albuquerque, NM 87112 (New Mexico residents add 4% sales tax). Credit card orders accepted by phone or mail. Personal checks will delay shipment. We will otherwise immediately ship you the TC-8 kit, the cabinet, the ribbon cable, the power adapter, an instruction manual, and a cassette containing the software.

✓92
JPC PRODUCTS CO.
**Phone (505) 294-4623**
**12021 Paisano Ct.**
**Albuquerque, N.M. 87112**

✓Reader Service—see page 257

*(from page 23)*

interface as a possible alternative to the TRS-80 expansion interface and stated that it had not been tested, since I didn't have access to the Radio Shack printer. It would appear that Mr. Keener has made this interface work with his modifications.

The pin assignments as shown are correct. The information on the pins that I gave in my article was from a Radio Shack manual and were obviously incorrect.

**Rod Hallen**
**State Dept.—Accra**
**Washington, D.C.**

## Same Tree, Different Fruit

My thanks to Ken Barbier of Borrego Engineering for his article "A New Branch on the Family Tree" in the October 1980 issue.

The NSC800 is indeed a fast CMOS implementation of the combined Zilog Z-80 and Intel 8085 features. One point in the article, however, was based on incorrect information published a while back. The NSC800 is *not* pin-for-pin identical to the 8085. It utilizes the same multiplexed bus structure but does not support the SID and SOD lines. The accompanying instructions, RIM and SIM, overlap coding areas of the Z-80 and are therefore not supported to preserve true Z-80 instruction compatibility.

In place of SID and SOD, the NSC800 has the Z-80 refresh line and a unique power save line. The NSC800 pin-out is designed to interface on a clean X-Y layout to its supporting chips.

**Anne Wagner-Korne**
**Product Marketing Manager**
**National Semiconductor**
**Santa Clara, CA**

# COMPUTER CLINIC

I'm looking for information on Apple Pascal. Our main application area is in teaching uses of the Apple, both for CAL and simulation studies. I'd like to know about any meetings or conferences taking place on these topics in the USA for a conference and at the same time sort out some of the Pascal problems.

**Dr. D. G. Jameson**
**The Middlesex Hospital**
**Medical School**
**Cleveland St.**
**London, England W1P 6DB**

I need to find a way to interface an Apple II to a Compugraphic phototypesetter. I wish to type, edit and correct on the Apple and then read the disk to the typesetter, allowing the proportional spacing feature to be retained.

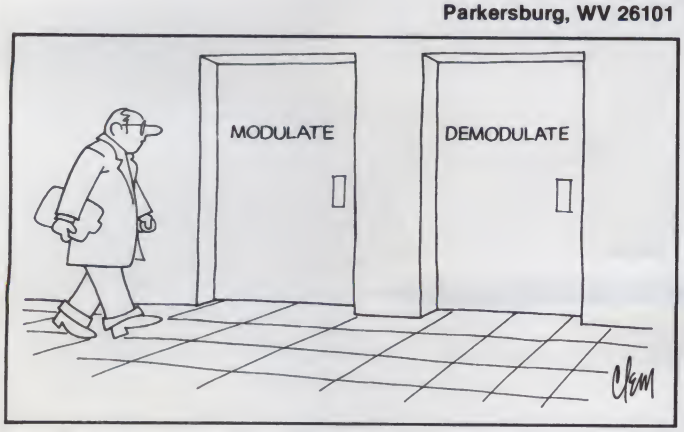
**Tim Keever**
**1025 Oak Ave. S., Box A32**
**Onalaska, WI 54650**

I am interested in a software package designed specifically for the stockbroker to input the numerical fields on a brokerage firm confirmation, perform various calculations on these fields, sort on a variety of these fields to produce a cross-referencing by individual stock or bond and then store and output the result. I'm currently using a 48K Apple II Plus with one disk and a Centronics microprinter. Any help along this line would be appreciated.

**Paul J. Robinson**
**PO Box 1969**
**Eugene, OR 97440**

I'm having difficulty locating a schematic or operating manual for the following piece of equipment. It looks like a modem but I want to be sure. It has a transmit and receive section. The model number on the receive station is 1CRCU-RS-1. The model number on the transmit section is 1CTCU-RS-1. It carries the Burroughs trademark on the case but it was made by Stelma, Inc. Burroughs and Stelma have not been able to help.

**Terry Hazelett**
**2107 Capitol Drive**
**Parkersburg, WV 26101**



# CLASSIFIEDS

Classified advertisements are intended for use by persons desiring to buy, sell or trade used computer equipment. No commercial ads are accepted.

Two sizes of ads are available. The $5 box allows up to 5 lines of about 35 characters per line, including spaces and punctuation. The $10 box allows up to 10 lines. Minimize use of capital letters to save space. No special layouts allowed. Payment is required in advance with ad copy. We cannot bill or accept credit.

Advertising text and payment must reach us 60 days in advance of publication (i.e., copy for March issue, mailed in February, must be here by Jan. 1). The publisher reserves the right to refuse questionable or inapplicable advertisements. Mail copy with payment to: **Classifieds, Kilobaud Microcomputing, Peterborough NH 03458.** Do not include any other material with your ad as it may be delayed.

---

For Sale: Two PDP8 systems. One is discrete element PDP8, one is PDP8/I. Both negative bus. Each 4K core memory, DF32 hard disk, DM01 multiplexer, PA60/61 high-speed paper tape punch/reader controllers. PDP8 has four TU55 tape drives, PDP8/I has two TU56 dual tape drives. Also several high-speed tape punches, several high-speed tape readers, all documentation, much software. Will consider offers for entire system or for individual units. Call or write Laurence A. Marschall, Department of Physics, Gettysburg College, Gettysburg, PA 17325. Phone: 717-334-3131.

---

For Sale: ASR-33 teletype with stand. Complete and in working order. Priced for quick sale at $250 plus shipping. Dick Carney, 1927 S. Dewey, Bartlesville, OK 74003, 918-336-3731.

---

For Sale: 32K CBM computer, C2N cassette drive and over $250 worth of software! Better than new! Used only 1 mo. Cost over $1600, new! Will sacrifice for $1000 or best offer! Scott Summer, 27 Leicester Way, Pawtucket, RI, 401-728-4678.

---

SWTPC 6800; 16K; MPA-2; MP-R; AC-30; TC-3; CFM-3; PMB-1; CT-64 (no case); GT-6144; PPG-J; all socketed; TSC software; invested $2400, asking $1400; also, Singer-Friden 30 cps printer, as is; $125. J. Quinlan, 5145 N. 10th St., Arlington, VA 22205, 703-243-4748.

---

Selectric terminal (AJ841). Excellent condition. Best offer. 402-895-2156.

---

For Sale: Netronics ELF II, two 4K RAM, Giant bd, ASCII keybd, PS, RF mod, light pen, Tiny BASIC. $670 worth for $335. Royal Dossett, 2795 Pheasant Rd, Excelsior, MN 55331, 612-471-9252.

---

For Sale: Rockwell AIM-65, 4K RAM ROM monitor, Enclosures Group large enclosure, all manuals, all new. $430. E. Velez, 19 Middleton Lane, Willingboro, NJ 08046.

---

For Sale: Wameco FPB-1 assembled/tested, $135. Wameco QMB-12 assembled/tested, $100. Both for $225. Will accept HP65 as partial payment. Daniel Snyder, 561 5th St., Butler, PA 16001 412-287-1625.

---

For Sale: Kim-1 with power supply 5 & 12 V, $125. Kimsi S-100, $75. 2 Mem-1 8K RAM by WMC, $75 ea. Ithaca Audio: EROM 16K with 12-2708s, $70: 1-A video display bd, 64 × 16 char, $50. 64 2102 RAM chips, $.50 each. Call Steve at 612-459-0533 after 6 PM.

---

For Sale: Heath H-89, 48K RAM, H88-2 port serial I/O, H88-5 cassette interface, H89-17 disk operating system (HDOS), H88-18 cassette software, all manuals, extra diskette, operates perfectly and looks new. First cashiers check for $1990, I'll ship. R. Van Cleave, 256 So. Tucson Cir., Aurora, CO 80012, 303-340-2955.

---

For Sale: Digital Group Z-80 microcomputer with 42K RAM, keyboard, monitor, 2 digital tape decks and much software. Complete $1300. Phone 805-968-5893 or write: Steven Fornell, 7536 Evergreen, Goleta, CA 93017.

---

For Sale: Netronics Elf II in steel enclosure; 2—4K static RAM bds; Giant bd; kluge bd; Math/ROM bd; tape cntrl bd; rf modulator; video display bd & ASCII kybd in steel enclosure; and expansion pwr supply. All for $700. Netronics software, courses & books. Worth $115. Incl. free. Money order preferred. Write J. Absetz, Box 696, USNSGA, FPO New York, NY 09518.

---

Diablo Hytype I Model 1200. Best of the "daisy wheel" printers. Brand new units w/pin feed friction platen & print wheel. Interface for Apple, TRS-80 & CP/M systems, maintenance manual and additional interface info available. There is no better buy anywhere. After 6 PM. Scott Priester, 211 White Water Ct., Greer, SC 29651, 803-268-0678.

---

For Sale: AJ 841 letter quality IO printer with hardware & software for TRS-80. Value $1500—make an offer. Call R. Clore, Jackson, MI, 517-563-2978.

---

TRS-80: Must sell, 32K Level II with 2 disk drives, 15 disks and 20 cassette tapes. Monitor not for sale. B. E. Brunick, 2710 4th St. N., Texas City, TX 77590, 713-945-6829.

---

Wanted: Software and/or accessories for Superbrain. Most interested in MBASIC or Micro-Ap SBASIC compiler. S. Grot, RD 1, Chadds Ford, PA 19317.

---

For Sale: Cromemco items with manuals: 2 Z-2 computers & Z-80 CPU card, $820 each. Tu-Art with 2 cables, $260. 4FDC disk controller, $350. 5-in. wfd single-side double density, $350. 8K Bytesaver II, $150. 8K Bytesaver I, $110. TV Dazzler, $240. D + 7A I/O, $240. Joystick JS-1W, $65. PRI printer interface, $150. 6 Godbout 8K Econoram II, $40 each. Make offer. D. G. Kissinger, School of Health, Loma Linda Univ., Loma Linda CA 92350, 714-796-7272.

---

For Sale with manuals: Mits 8800A, 13 slots, $350. Mits 2SI/O, $140. Mits 4K dyn mem, $25. PT VDM display board, $150. PT 4K static, $25. 2 Tarbell cassette interface, $80 each. 2 SD Sales 16K EPROM card, $75 each. 2 U/L keyboard, $50 each. Make offer. D. G. Kissinger, School of Health, Loma Linda Univ., Loma Linda, CA 92350, 714-796-7272.

---

Lear Seigler ADM-3 CRT for sale. Any reasonable offer accepted. Jim Pazarena, Box 550, Queen Charlotte, BC Canada V0T 1S0.

---

**Use the Classifieds**

---

**Please type all ads, double-spaced, or print clearly, also double-spaced.**

# DEALER DIRECTORY



# CLUB NOTES

## Winston-Salem, NC

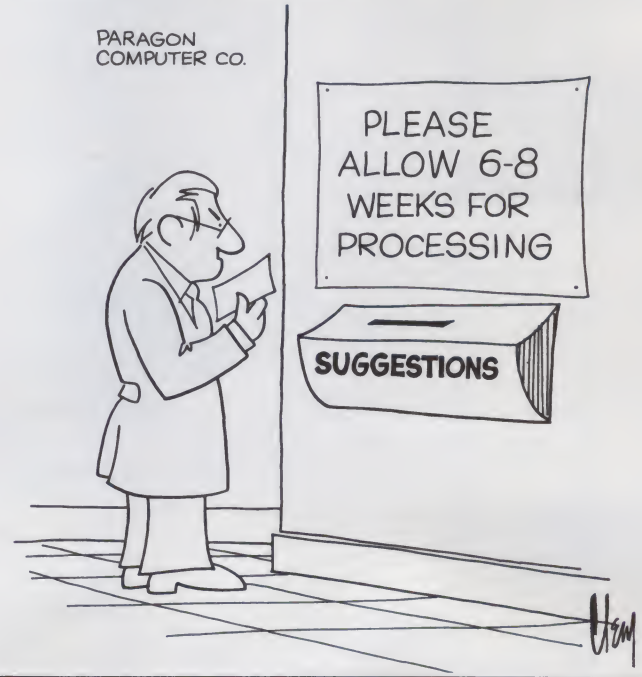
The Triad Heath Users Group invites those interested to attend their monthly meetings at the Sears Activity Room at Hanes Mall in Winston-Salem, NC, on the second Saturday of each month at 1 PM. For additional information, contact Steve Minor, 424 Cliffdale Drive, Winston-Salem, NC 27104, (919-765-7717), or Hughes Hoyle in Greensboro at 919-378-1050.

## El Monte, CA

The ET-3400 Users Group is a new club that is seeking to collect and distribute information for ET-3400 owners. Articles, letters and programs are being sought. Those interested should contact the ET-3400 Users Group, c/o Charles Van Dyke, 11231 Oak St., El Monte, CA 91731. 24-hour message phone: 213-443-2237; Compuserve no. 70250,463.

## Seattle, WA

The NW PET Users Group has a new address and meeting place. On the second Tuesday of the month, the meeting is held at the Academic Computer Center at the University of Washington. For further information, contact Richard Ball, 2565 Dexter N. #203, Seattle, WA 98109, (206-284-9417).




## MICRO QUIZ

*(from page 12)*

**Answer: 61.**
Statement 30 is executed initially and then once each time that L increases in value from 12 to 72. Thus, $1 + 72 - 12 = 61$.

# 1980 INDEX

**Dear Subscriber:**

**Kilobaud Microcomputing does not keep subscription records on the premises. Therefore, calling the Peterborough offices doesn't solve your subscription problem.**

**To quickly solve your problem, please send your most recent address label and a description of the problem to:**

**Kilobaud Microcomputing**
**Subscription Department**
**PO Box 997**
**Farmingdale, NY 11737**

**Please allow the subscription department at least two weeks for an answer or a solution to your problem.**

**Thank you and enjoy your subscription.**

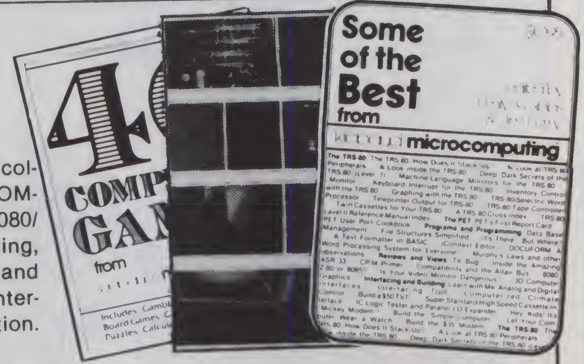
**Sincerely,**

**Debra L. Boudrieau**
**Circulation Manager**

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION (Required by 39 U.S.C. 3685). 1. Title of publication, *Kilobaud Microcomputing*. 2. Date of filing, Oct. 1, 1980. 3. Frequency of issue, Monthly. A. No. of issues published annually, 12. B. Annual subscription price, $25.00. 4. Location of known office of publication (Street, City, County, State and ZIP Code) (Not printers), 80 Pine Street, Peterborough, Hillsboro County, N.H. 03458. 5. Location of the headquarters or general business offices of the publishers (Not printers), 80 Pine Street, Peterborough, Hillsboro County, N.H. 03458. 6. Names and complete addresses of publisher, editor and managing editor. Publisher (Name and Address), Wayne Green, Peterborough, N.H. 03458. Editor (Name and Address), Wayne Green, Peterborough, N.H. 03458. Managing Editor (Name and Address), Dennis Brisson, Swanzey Lake Road, Winchester, N.H. 03470. 7. Owner (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual must be given. If the publication is published by a nonprofit organization, its name and address must be stated.) Name, 1001001, Inc., Peterborough, N.H. 03458. Wayne Green, Peterborough, N.H. 03458. 8. Known bondholders, mortgagees and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages or other securities (If there are none, so state) Name, none. 9. For completion by nonprofit organizations authorized to mail at special rates (Section 132.122, PSM) The purpose, function and nonprofit status of this organization and the exempt status for Federal income tax purposes (Check one) Not applicable. 10. Extent and nature of circulation. (X) Average No. copies each issue during preceding 12 months. (Y) Actual No. copies of single issue published nearest to filing date. A. Total No. of copies printed (Net Press Run) (X) 88,823 (Y) 89,649. B. Paid circulation 1. Sales through dealers and carriers, street vendors and counter sales, (X) 21,188 (Y) 19,270. 2. Mail subscriptions (X) 61,165 (Y) 61,313. C. Total paid circulation (Sum of 10B1 and 10B2) (X) 82,353 (Y) 80,583. D. Free distribution by mail, carrier or other means samples, complimentary, and other free copies (X) 418 (Y) 559. E. Total distribution (Sum of C and D) (X) 82,771 (Y) 81,142. F. Copies not distributed 1. Office use, left over, unaccounted, spoiled after printing (X) 4,881 (Y) 7,336. 2. Returns from news agents (X) 1,171 (Y) 1,171. G. Total (Sum of E, F1 and 2—should equal net press run shown in A) (X) 88,823 (Y) 89,649. 11. I certify that the statements made by me above are correct and complete. Signature and title of editor, publisher, business manager, or owner. Debra Boudrieau, Business Manager.

# kb microcomputing book nook

## 3 NEW BOOKS

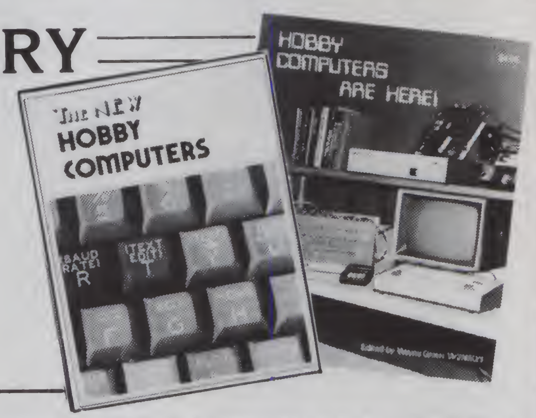



● **SOME OF THE BEST FROM KILOBAUD/MICROCOMPUTING**—BK7311—A collection of the best articles that have recently appeared in Kilobaud/MICROCOMPUTING. Included is material on the TRS-80 and PET systems, CP/M, the 8080/8085/Z80 chips, the ASR-33 terminal. Data base management, word processing, text editors and file structures are covered too. Programming techniques and hardcore hardware construction projects for modems, high speed cassette interfaces and TVTs are also included in this large format, 200 plus page edition. $10.95.*

● **UNDERSTANDING AND PROGRAMMING MICROCOMPUTERS**—BK7382—A valuable addition to your computing library. This two part text includes the best articles that have appeared in 73 and Kilobaud Microcomputing magazines on the hardware and software aspects of the new microcomputing hobby. Well known authors and well structured text helps the reader get involved in America's fastest growing hobby. $10.95*

● **40 COMPUTER GAMES**—BK7381—Forty games in all in nine different categories. Games for large and small systems, and even a section on calculator games. Many versions of BASIC used and a wide variety of systems represented. A must for the serious computer gamesman. $7.95*

## INTRODUCTORY




● **HOBBY COMPUTERS ARE HERE!**—BK7322—If you (or a friend) want to come up to speed on how computers work . . . hardware and software . . . this is an excellent book. It starts with the fundamentals and explains the circuits, and the basics of programming. This book has the highest recommendations as a teaching aid for newcomers. $4.95.*

● **THE NEW HOBBY COMPUTERS**—BK7340—This book takes it from where "HOBBY COMPUTERS ARE HERE!" leaves off, with chapters on Large Scale Integration, how to choose a microprocessor chip, an introduction to programming, low cost I/O for a computer, computer arithmetic, checking memory boards . . . and much, much more! Don't miss this tremendous value! Only $4.95.*

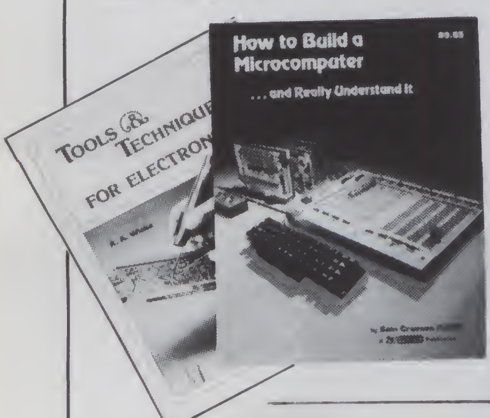
### *INTRODUCTION TO MICROCOMPUTERS (VOL. 0→III)*

● **AN INTRODUCTION TO MICROCOMPUTERS, VOL. 0**—BK1130—The Beginner's Book—Written for readers who know nothing about computers—for those who have an interest in how to use computers—and for everyone else who must live with computers and should know a little about them. The first in a series of 4 volumes, this book will explain how computers work and what they can do. Computers have become an integral part of life and society. During any given day you are affected by computers, so start learning more about them with Volume 0. $7.95.*

● **VOL. I**—BK1030—**2nd Edition completely revised.** Dedicated to the basic concepts of microcomputers and hardware theory. The purpose of Volume I is to give you a thorough understanding of what microcomputers are. From basic concepts (which are covered in detail), Volume I builds the necessary components of a microcomputer system. This book highlights the difference between minicomputers and microcomputers. $12.50.*

● **VOL. II**—BK1040 (with binder)—$30.00*—Contains descriptions of individual microprocessors and support devices used only with the parent microprocessor. Volume II describes all available chips.

● **VOL. III**—BK1133 (with binder)—$20.00.* Contains descriptions of all support devices that can be used with any microprocessor.




● **HOW TO BUILD A MICROCOMPUTER—AND REALLY UNDERSTAND IT**—BK7325—by Sam Creason. The electronics hobbyist who wants to build his own microcomputer system now has a practical "How-To" guidebook. This book is a combination technical manual and programming guide that takes the hobbyist step-by-step through the design, construction, testing and debugging of a complete microcomputer system. Must reading for anyone desiring a true understanding of small computer systems. $9.95.*

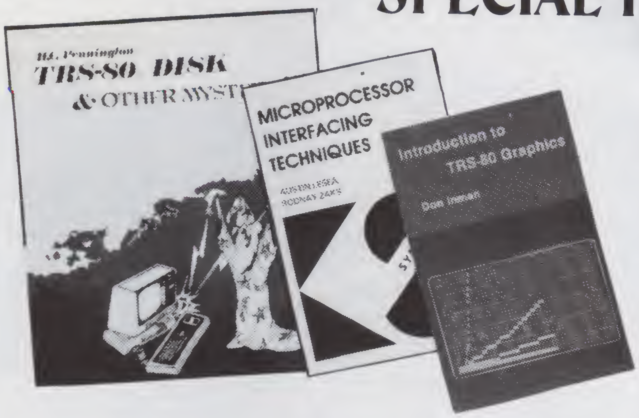
● **TOOLS & TECHNIQUES FOR ELECTRONICS**—BK7348—by A. A. Wicks is an easy-to-understand book written for the beginning kit builder as well as the experienced hobbyist. It has numerous pictures and descriptions of the safe and correct ways to use basic and specialized tools for electronic projects as well as specialized metal working tools and the chemical aids which are used in repair shops. $4.95.*

*Use the order card in the back of this magazine or itemize your order on a separate piece of paper and mail to Kilobaud *Microcomputing* Book Department • Peterborough NH 03458. Be sure to include check or detailed credit card information. No C.O.D. orders accepted. All orders add $1.00 handling. Please allow 4-6 weeks for delivery. Questions regarding your order? Please write to Customer Service at the above address.

**FOR TOLL FREE ORDERING CALL 1-800-258-5473**

# kb microcomputing book nook

## SPECIAL INTERESTS




●**TRS-80 DISK AND OTHER MYSTERIES**—BK1181—by Harvard C. Pennington. This is the definitive work on the TRS-80 disk system. It is full of detailed "How to" information with examples, samples and in-depth explanations suitable for beginners and professionals alike. The recovery of one lost file is worth the price alone. $22.50.*

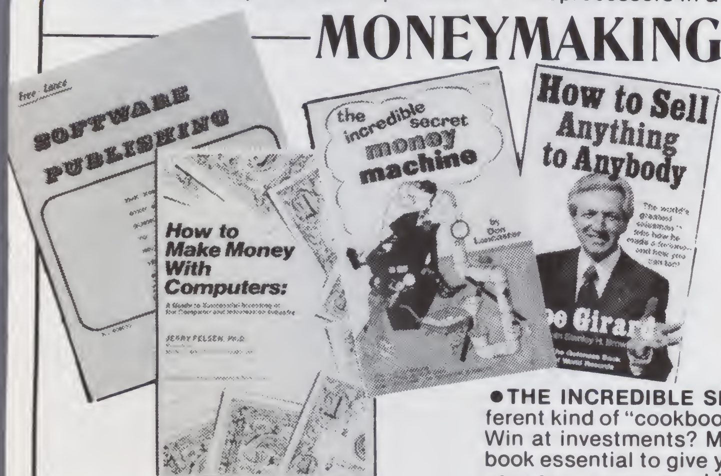
●**INTRODUCTION TO TRS-80 GRAPHICS**—BK1180—by Don Inman. Dissatisfied with your Level I or Level II manual's coverage of graphics capabilities? This well-structured book (suitable for classroom use) is ideal for those who want to use all the graphics capabilities built into the TRS-80. A tutorial method is used with many demonstrations. It is based on the Level I, but all material is suitable for Level II use. $8.95.*

●**MICROPROCESSOR INTERFACING TECHNIQUES**—BK1037—by Austin Lesea & Rodnay Zaks will teach you how to interconnect a complete system and interface it to all the usual peripherals. It covers hardware and software skills and techniques, including the use and design of model buses such as the IEEE 488 or S100. $15.95.*

●**MICROPROCESSOR LEXICON—ACRONYMS AND DEFINITIONS**—BK1137—Compiled by the staff of SYBEX is a convenient reference in pocket size format. Sections include acronyms and definitions, part numbers and their definitions, S-100 signals, RS232 signals, IEEE 499 signals, microcomputer and microprocessors, JETDS summary (military) and a code conversion table. $2.95.*

●**MICROPROCESSORS FROM CHIPS TO SYSTEMS**—BK1036—by Rodnay Zaks is a complete and detailed introduction to microprocessors and microcomputer systems. No preliminary knowledge of computers or microprocessors is required to read this book, although a basic engineering knowledge is naturally an advantage. Intended for all wishing to understand the concepts, techniques and components of microprocessors in a short time. $10.95.*

## MONEYMAKING




●**HOW TO MAKE MONEY WITH COMPUTERS**—BK1003—In 10 information-packed chapters, Jerry Felsen describes more than 30 computer-related, money-making, high profit, low capital investment opportunities. $15.00.*

●**HOW TO SELL ANYTHING TO ANYBODY**—BK7306—According to *The Guinness Book of World Records*, the author, Joe Girard, is "the world's greatest salesman." This book reveals how he made a fortune—and how you can, too. $2.25.*

●**FREELANCE SOFTWARE PUBLISHING**—BK1179—by B. J. Korites. "This book is about money and how to make it by writing and selling computer programs," (author's foreword). If you have the skills to write a saleable program, you now need to acquire the skills to sell that program. This compact book comprehensively covers the entire publishing process and many aspects of software salesmanship. $14.95.*

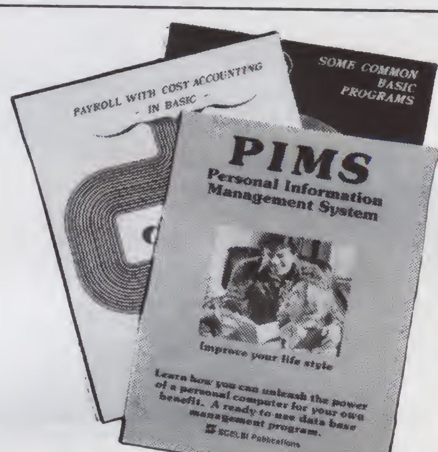
●**THE INCREDIBLE SECRET MONEY MACHINE**—BK1178—by Don Lancaster. A different kind of "cookbook" from Don Lancaster. Want to slash taxes? Get free vacations? Win at investments? Make money from something that you *like* to do? You'll find this book essential to give you the key insider details of what is really involved in starting up your own money machine. $5.95.*

## BUSINESS

●**PAYROLL WITH COST ACCOUNTING—IN BASIC**—BK1001—by L. Poole & M. Borchers, includes program listings with remarks, descriptions, discussions of the principle behind each program, file layouts, and a complete user's manual with step-by-step instructions, flowcharts, and simple reports and CRT displays. Payroll and cost accounting features include separate payrolls for up to 10 companies, time-tested interactive data entry, easy correction of data entry errors, job costing (labor of distribution), check printing with full deduction and pay detail, and 16 different printed reports, including W-2 and 941 (in **CBASIC**). $20.00.*

●**SOME COMMON BASIC PROGRAMS**—BK1053—published by Adam Osborne & Associates, Inc. Perfect for non-technical computerists requiring ready-to-use programs. Business programs, plus miscellaneous programs. Invaluable for the user who is not an experienced programmer. All will operate in the stand-alone mode. $12.50 paperback.*

●**PIMS: PERSONAL INFORMATION MANAGEMENT SYSTEM**—BK1009—Learn how to unleash the power of a personal computer for your own benefit in this ready-to-use data-base management program. $11.95.*




*Use the order card in the back of this magazine or itemize your order on a separate piece of paper and mail to Kilobaud *Microcomputing* Book Department • Peterborough NH 03458. Be sure to include check or detailed credit card information. No C.O.D. orders accepted. All orders add $1.00 handling. Please allow 4-6 weeks for delivery. Questions regarding your order? Please write to Customer Service at the above address.

**FOR TOLL FREE ORDERING CALL 1-800-258-5473**

# kb microcomputing book nook

## —PROGRAMMING & COOK BOOKS—


### —Z80—

new!

● **INSIDE LEVEL II** — BK1183 — For machine language programmers! This is a comprehensive reference guide to the Level II ROMs, allowing easy utilization of the sophisticated routines they contain. It concisely explains set-ups, calling sequences, variable passage and I/O routines. Part II presents an entirely new composite program structure which unloads under the SYSTEM command and executes in both BASIC and machine code with the speed and efficiency of a compiler. Special consideration is given to disk systems. $15.95.*

● **PROGRAMMING THE Z-80** — BK1122 — by Rodnay Zaks. Here is assembly language programming for the Z-80 presented as a progressive, step-by-step course. This book is both an educational text *and* a self-contained reference book, useful to both the beginning and the experienced programmer who wish to learn about the Z-80. Exercises to test the reader are included. $14.95.*

● **Z-80 ASSEMBLY LANGUAGE PROGRAMMING** — BK1177 — by Lance A. Leventhal. This book thoroughly covers the Z80 instruction set, abounding in simple programming examples which illustrate software development concepts and actual assembly language usage. Features include Z80 I/O devices and interfacing methods, assembler conventions, and comparisons with 8080A/8085 instruction sets and interrupt structure. $16.99.*

● **Z-80 SOFTWARE GOURMET GUIDE AND COOKBOOK** — BK1045 — by Nat Wadsworth. Scelbi's newest cookbook! This book contains a complete description of the powerful Z-80 instruction set and a wide variety of programming information. Use the author's ingredients including routines, subroutines and short programs, choose a time-tested recipe and start cooking! $15.95.*

### —6502—

● **PROGRAMMING THE 6502 (Second Edition)** — BK1005 — Rodnay Zaks has designed a self-contained text to learn programming, using the 6502. It can be used by a person who has never programmed before, and should be of value to anyone using the 6502. The many exercises will allow you to test yourself and practice the concepts presented. $12.95.*

● **6502 APPLICATIONS BOOK** — BK1006 — Rodnay Zaks presents practical-application techniques for the 6502 microprocessor, assuming an elementary knowledge of microprocessor programming. You will build and design your own domestic-use systems and peripherals. Self-test exercises included. $12.95.*

● **6502 ASSEMBLY LANGUAGE PROGRAMMING**—BK1176—by Lance A. Leventhal. This book provides comprehensive coverage of the 6502 microprocessor assembly language. Leventhal covers over 80 programming examples from simple *memory* load loops to complete design projects. Features include 6502 assembler conventions, input/output devices and interfacing methods, and programming the 6502 interrupt system. $16.99.*

● **6502 SOFTWARE GOURMET GUIDE AND COOKBOOK** — BK1055 — by Robert Findley. This book introduces the BASIC language programmer into the realm of machine-language programming. The description of the 6502 structure and instruction set, various routines, subroutines and programs are the ingredients in this cookbook. "Recipes" are included to help you put together exactly the programs to suit your taste. $12.95.*

### —8080 / 8080A—

● **8080A/8085 Assembly Language Programming**—by Lance Leventhal—BK1004—Assembly language programming for the 8080A/8085 is explained with a description of the functions of assemblers and assembly instructions, and a discussion of basic software development concepts. Many fully debugged, practical programs are included as is a special section on structured programming. $12.50.*

● **8080 PROGRAMMING FOR LOGIC DESIGN**—BK1078—Ideal reference for an indepth understanding of the 8080 processor. Application-oriented and the 8080 is discussed in light of replacing conventional, hard-wired logic. Practical design considerations are provided for the implementation of an 8080-base control system. $9.50.*

● **8080 SOFTWARE GOURMET GUIDE AND COOKBOOK** — BK1102 — If yu have been spending too much time developing simple routines for your 8080, try this new book by Scelbi Computing and Robert Findley. Describes sorting, searching, and many other routines for the 8080 user. $12.95.*

### —6800—

● **6800 PROGRAMMING FOR LOGIC DESIGN**—BK1077—Oriented toward the industrial user, this book describes the process by which conventional logic can be replaced by a 6800 microprocessor. Provides practical information that allows an experimenter to design a complete micro control system from the "ground up." $9.50.*

● **6800 SOFTWARE GOURMET GUIDE AND COOKBOOK** — BK1075 — Like its culinary cousin, *The 8080 Gourmet Guide*, this book by Scelbi Computing and Robert Findley describes sorting, searching and other routines — this time for the 6800 user. $12.95.*

### —COOK BOOKS—

● **CMOS COOKBOOK** — BK1011 — by Don Lancaster. Details the application of CMOS, the low power logic family suitable for most applications presently dominated by TTL. Required reading for every serious digital experimenter! $10.50.*

● **TVT COOKBOOK** — BK1064 — by Don Lancaster. Describes the use of a standard television receiver as a microprocessor CRT terminal. Explains and describes character generation, cursor control and interface information in typical, easy-to-understand Lancaster style. $9.95.*

● **TTL COOKBOOK** — BK1063 — by Donald Lancaster. Explains what TTL is, how it works, and how to use it. Discusses practical applications, such as a digital counter and display system, events counter, electronic stopwatch, digital voltmeter and a digital tachometer. $9.50.*

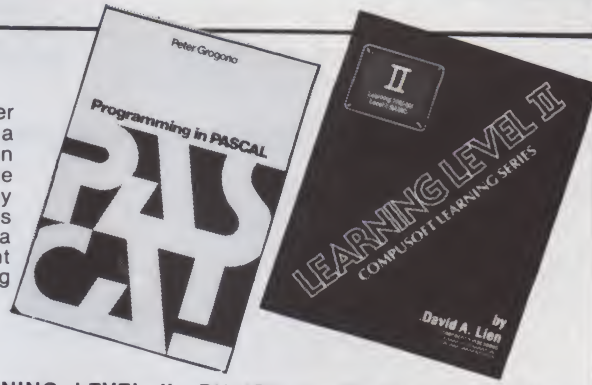
● ***MICROCOMPUTING* CODING SHEETS** ***Microcomputing*'s** dozen or so programmers wouldn't try to work without these handy scratch pads, which help prevent the little errors that can cost hours and hours of programming time. Available for programming is Assembly/Machine Language (PD1001), which has columns for address, instruction (3 bytes), source code (label, op code, operand) and comments; and for BASIC (PD1002) which is 72 columns wide. 50 sheets to a pad. $2.39.*

*Use the order card in the back of this magazine or itemize your order on a separate piece of paper and mail to Kilobaud *Microcomputing* Book Department • Peterborough NH 03458. Be sure to include check or detailed credit card information. No C.O.D. orders accepted. All orders add $1.00 handling. Please allow 4-6 weeks for delivery. Questions regarding your order? Please write to Customer Service at the above address.

**FOR TOLL FREE ORDERING CALL 1-800-258-5473**

# kb microcomputing book nook

## BASIC AND PASCAL




***NEW REVISED EDITION***

● **PROGRAMMING IN PASCAL**—BK1140—by Peter Grogono. The computer programming language PASCAL was the first language to embody in a coherent way the concepts of structured programming, which has been defined by Edsger Dijkstra and C.A.R. Hoare. As such, it is a landmark in the development of programming languages. PASCAL was developed by Niklaus Wirth in Zurich; it is derived from the language ALGOL 60 but is more powerful and easier to use. PASCAL is now widely accepted as a useful language that can be efficiently implemented, and as an excellent teaching tool. It does not assume knowledge of any other programming language; it is therefore suitable for an introductory course. $12.95.*

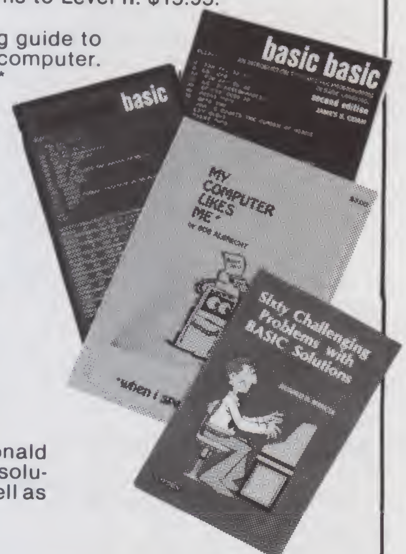
● **THE BASIC HANDBOOK**—BK1174—by David Lien. This book is unique. It is a virtual ENCYCLOPEDIA of BASIC. While not favoring one computer over another, it explains over 250 BASIC words, how to use them and alternate strategies. If a computer does not possess the capabilities of a needed or specified word, there are often ways to accomplish the same function by using another word or combination of words. That's where the HANDBOOK comes in. It helps you get the most from your computer, be it a "bottom-of-the-line" micro or an oversized monster. $14.95.*

● **LEARNING LEVEL II**—BK1175—by David Lien. Written especially for the TRS-80, this book concentrates on Level II BASIC, exploring every important BASIC language capability. Updates are included for those who have studied the Level I User's Manual. Sections include: how to use the Editor, dual cassette operation, printers and peripheral devices, and the conversion of Level I programs to Level II. $15.95.*


● **BASIC NEW 2ND EDITION**—BK1081—by Bob Albrecht. Self-teaching guide to the computer language you will need to know for use with your microcomputer. This is one of the easiest ways to learn computer programming. $6.95.*

● **BASIC BASIC (2ND EDITION)**—BK1026—by James S. Coan. This is a textbook which incorporates the learning of computer programming using the BASIC language with the teaching of mathematics. Over 100 sample programs illustrate the techniques of the BASIC language and every section is followed by practical problems. This second edition covers character string handling and the use of data files. $9.45.*

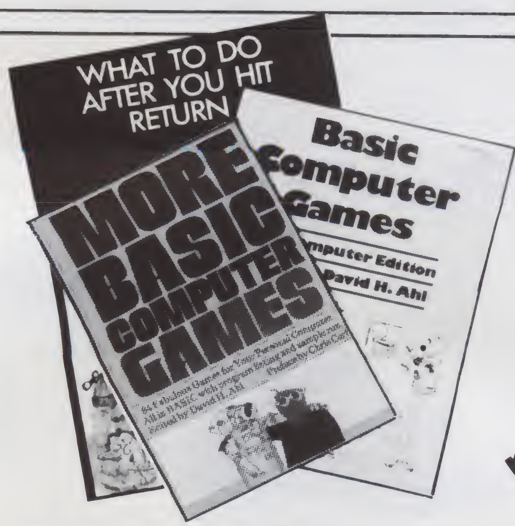
● **ADVANCED BASIC**—BK1000—Applications, including strings and files, coordinate geometry, area, sequences and series, simulation, graphing and games. $9.65*.




● **MY COMPUTER LIKES ME . . . WHEN I SPEAK BASIC**—BK1039—An introduction to BASIC . . . simple enough for kids. If you want to teach BASIC to anyone quickly, this is the way to go. $3.95.*

● **SIXTY CHALLENGING PROBLEMS WITH BASIC SOLUTIONS (2nd Edition)**—BK1073—by Donald Spencer, provides the serious student of BASIC programming with interesting problems and solutions. No knowledge of math above algebra required. Includes a number of game programs, as well as programs for financial interest, conversions and numeric manipulations. $6.95.*

## GAMES




● **WHAT TO DO AFTER YOU HIT RETURN**—BK1071—PCC's first book of computer games . . . 48 different computer games you can play in BASIC . . . programs, descriptions, many illustrations. Lunar Landing, Hammurabi, King, Civel 2, Qubic 5, Taxman, Star Trek, Crash, Market, etc. *$10.95.**

● **BASIC COMPUTER GAMES**—BK1074—Okay, so once you get your computer and are running in BASIC, then what? Then you need some programs in BASIC, that's what. *This book has* 101 games for you from very simple to real buggers. You get the games, a description of the games, the listing to put in your computer and a sample run to show you how they work. Fun. Any one game will be worth more than the price of the book for the fun you and your family will have with it. $7.50.*

new!

● **MORE BASIC COMPUTER GAMES**—BK1182—edited by David H. Ahl. More fun in BASIC! 84 new games from the people who brought you *BASIC Computer Games*. Includes such favorites as Minotaur (battle the mythical beast) and Eliza (unload your troubles on the doctor at bargain rates). Complete with game description, listing and sample run. $7.50.*

*Use the order card in the back of this magazine or itemize your order on a separate piece of paper and mail to Kilobaud *Microcomputing* Book Department • Peterborough NH 03458. Be sure to include check or detailed credit card information. No C.O.D. orders accepted. All orders add $1.00 handling. Please allow 4-6 weeks for delivery. Questions regarding your order? Please write to Customer Service at the above address.

**FOR TOLL FREE ORDERING CALL 1-800-258-5473**

# The Sale Ends

# Prices to increase as

## S-100 Boards

### THE BIG Z* - Jade
*2 or 4 MHz switchable Z-80* CPU with serial I/O*

| | | |
|---|---|---|
| CPU-30201K | *Kit* | $145.00 |
| CPU-30201A | *A & T* | $199.00 |
| CPU-30200B | *Bare board* | $35.00 |

### SBC-100 - SD Systems
*2.5 MHz Z-80* CPU with serial & parallel I/O ports*

| | | |
|---|---|---|
| CPC-30100K | *Kit* | $269.95 |
| CPC-30100A | *Jade A & T* | $339.95 |

### SBC-200 - SD Systems
*4 MHz Z-80* CPU with serial & parallel I/O ports*

| | | |
|---|---|---|
| CPC-30200K | *Kit* | $299.95 |
| CPC-30200A | *Jade A & T* | $375.00 |

### CB2 - S.S.M.
*2 or 4 MHz switchable Z-80* CPU with RAM, ROM, & I/O*

| | | |
|---|---|---|
| CPU-30300K | *Kit* | $239.95 |
| CPC-30300A | *A & T* | $299.95 |

### 2810 Z-80* CPU - Cal Comp Sys
*2/4 MHz Z-80A* CPU w/serial I/O port*

| | | |
|---|---|---|
| CPU-30400A | *A & T* | $275.00 |

*64K RAM BOARD $359.95*

### ExpandoRAM II - SD Systems
*4 MHz RAM board expandable from 16K to 256K*

| | | |
|---|---|---|
| MEM-16630A | *16K kit* | $249.95 |
| MEM-16630A | *16K Jade A & T* | $299.95 |
| MEM-32631K | *32K kit* | $289.95 |
| MEM-32631A | *32K Jade A & T* | $339.95 |
| MEM-48632K | *48K kit* | $324.95 |
| MEM-48631A | *48K Jade A & T* | $374.95 |
| MEM-64633K | *64K kit* | $359.95 |
| MEM-64633A | *64K Jade A & T* | $409.95 |

### ExpandoRAM I - SD Systems
*2.5 MHz RAM board expandable from 16K to 64K*

| | | |
|---|---|---|
| MEM-16130K | *16K kit* | $245.00 |
| MEM-16130A | *16K Jade A & T* | $295.00 |
| MEM-32131K | *32K kit* | $275.00 |
| MEM-32131A | *32K Jade A & T* | $325.00 |
| MEM-48132K | *48K kit* | $305.00 |
| MEM-48132A | *48K Jade A & T* | $355.00 |
| MEM-64133K | *64K kit* | $335.00 |
| MEM-64133A | *64K Jade A & T* | $385.00 |

*32K STATIC RAM BOARD $299.95*

*16K STATIC RAM BOARD $169.95*

### 32K STATIC RAM - Jade
*2 or 4 MHz expandable static RAM board uses 2114L's*

| | | |
|---|---|---|
| MEM-16151K | *16K 4 MHz kit* | $169.95 |
| MEM-16151A | *16K 4 MHz A & T* | $224.95 |
| MEM-32151K | *32K 4 MHz kit* | $299.95 |
| MEM-32151A | *32K 4 MHz A & T* | $349.95 |

### 16K STATIC RAM - Cal Comp Sys
*2 or 4 MHz 16K static RAM - a real memory bargain*

| | | |
|---|---|---|
| MEM-16160A | *16K 2 MHz A & T* | $279.00 |
| MEM-16162A | *16K 4 MHz A & T* | $309.00 |
| MEM-16160B | *Bare board* | $29.95 |

### PB-1 - S.S.M.
*2708, 2716 EPROM board with built-in programmer*

| | | |
|---|---|---|
| MEM-99510K | *Kit* | $159.95 |
| MEM-99510A | *A & T* | $239.95 |

### PROM-100 - SD Systems
*2708, 2716, 2732, 2758, & 2516 EPROM programmer*

| | | |
|---|---|---|
| MEM-99520K | *Kit* | $175.00 |
| MEM-99520A | *Jade A & T* | $225.00 |

### S.P.I.C. - Jade
*Our new I/O card with 2 SIO's, 4 CTC's, and 1 PIO*

| | | |
|---|---|---|
| IOI-1045K | *2 CTC's, 1 SIO, 1 PIO* | $199.00 |
| IOI-1045A | *A & T* | $259.00 |
| IOI-1046K | *4 CTC's, 2 SIO's, 1 PIO* | $259.00 |
| IOI-1046A | *A & T* | $319.00 |
| IOI-1045B | *Bare board w/ manual* | $59.95 |
| IOI-1045D | *Manual only* | $20.00 |

### I/O-4 - S.S.M.
*2 serial I/O ports plus 2 parallel I/O ports*

| | | |
|---|---|---|
| IOI-1010K | *Kit* | $179.95 |
| IOI-1010A | *A & T* | $259.95 |
| IOI-1010B | *Bare board* | $35.00 |

### 100K DAY CLOCK - Mtn Hardware
*Crystal controlled S-100 clock with NiCad backup*

| | | |
|---|---|---|
| IOK-1400A | *A & T* | $329.95 |

### SB1 - S.S.M.
*15 Hz to 25K Hz music synthesizer for S-100*

| | | |
|---|---|---|
| IOS-1005K | *Kit* | $239.95 |
| IOS-1005A | *A & T* | $299.95 |

### TB-4 - Mullen
*Extremely versatile extender board with logic probe*

| | | |
|---|---|---|
| TSX-180K | *Kit* | $55.00 |
| TSX-180A | *A & T* | $75.00 |

### TERMINATOR & EXTENDER - C.C.S.
*Can be used as both an S-100 extender and terminator*

| | | |
|---|---|---|
| TSX-150K | *Kit* | $39.95 |

### S-100 EXTENDER - Cal Comp Sys
*Puts problem boards within easy reach*

| | | |
|---|---|---|
| TSX-160A | *A & T* | $24.95 |

### DOUBLE-D - Jade
*Double density controller with the inside track*

| | | |
|---|---|---|
| IOD-1200K | *Kit* | $299.95 |
| IOD-1200A | *8" A & T* | $389.95 |
| IOD-1205A | *5¼" A & T* | $389.95 |
| IOD-1200B | *Bare board* | $65.00 |

### VERSAFLOPPY I - SD Systems
*Versatile floppy disk controller for 8" or 5¼"*

| | | |
|---|---|---|
| IOD-1150K | *Kit* | $219.95 |
| IOD-1150A | *Jade A & T* | $269.95 |

### VERSAFLOPPY II - SD Systems
*New double density controller for both 8" & 5¼"*

| | | |
|---|---|---|
| IOD-1160K | *Kit* | $309.95 |
| IOD-1160A | *Jade A & T* | $369.95 |

### VDB-8024 - SD Systems
*80 x 24 I/O mapped video board with keyboard I/O*

| | | |
|---|---|---|
| IOV-1020K | *Kit* | $339.95 |
| IOV-1020A | *Jade A & T* | $399.95 |

### VB3 - S.S.M.
*80 x 24 or 80 x 48 memory mapped with graphics*

| | | |
|---|---|---|
| IOV-1095K | *Kit, 4 MHz* | $399.95 |
| IOV-1095A | *A & T, 4 MHz* | $464.95 |
| IOV-1096K | *80 x 48 upgrade, 4 MHz* | $89.00 |

### VIDEO BOARD - Jade
*64 x 16 assembled & tested S-100 video board*

| | | |
|---|---|---|
| IOV-1050B | *Bare board* | $29.95 |
| IOV-1050A | *A & T sale price* | $99.95 |

### S-100 PROTO BOARD - Jade
*Universal design, plated thru holes, gold fingers*

| | | |
|---|---|---|
| TSX-140B | *Bare board* | $24.95 |

*CP/M is a registered trademark of Digital Research Corp.

* Z-80, Z-80A, and the letter Z are recognized trademarks of Zilog, Inc.

## Single Board Computers

### Z-80* STARTER KIT - SD Systems
*Z-80* computer with RAM, ROM, I/O, & keyboard*

| | | |
|---|---|---|
| CPS-30010K | *Kit* | $319.95 |
| CPS-30010A | *Jade A & T* | $399.95 |

### AIM-65 - Rockwell
*6502 computer with printer, display, & keyboard*

| | | |
|---|---|---|
| CPK-50165 | *1K AIM* | $374.95 |
| CPK-50465 | *4K AIM* | $449.95 |
| SFK-74600008E | *8K BASIC ROM* | $99.95 |
| SFK-64600004E | *4K assembler ROM* | $84.95 |
| PSX-030A | *Power supply* | $64.95 |
| ENX-000002 | *Enclosure* | $49.95 |

*4K AIM, 8K BASIC, power supply, & enclosure*

**Special package price** ............ $625.00

## Motherboards

### ISO-BUS - Jade
*Silent, simple, and on sale - a better motherboard*

6 Slot (5¼" x 8⅝")

| | | |
|---|---|---|
| MBS-061B | *Bare board* | $19.95 |
| MBS-061K | *Kit* | $39.95 |
| MBS-061A | *A & T* | $49.95 |

12 Slot (9¾" x 8⅝")

| | | |
|---|---|---|
| MBS-121B | *Bare board* | $29.95 |
| MBS-121K | *Kit* | $69.95 |
| MBS-121A | *A & T* | $89.95 |

18 Slot (14½" x 8⅝")

| | | |
|---|---|---|
| MBS-181B | *Bare board* | $49.95 |
| MBS-181K | *Kit* | $99.95 |
| MBS-181A | *A & T* | $139.95 |

## Mainframes

### MAINFRAME - Cal Comp Sys
*12 slot S-100 mainframe with 20 amp power supply*

| | | |
|---|---|---|
| ENC-112105 | *Kit* | $309.95 |
| ENC-112106 | *A & T* | $349.95 |

### DISK MAINFRAME - NNC
*Dual 8" drive cutouts with 8 slot motherboard*

| | | |
|---|---|---|
| ENS-112320 | *with 30 amp p.s.* | $699.95 |

## Video Monitors

### 9" B & W MONITOR - A.P.F.
*High quality, high resolution video monitor*

| | | |
|---|---|---|
| VDM-750900 | *9" monitor* | $149.95 |

### 13" COLOR MONITOR - Zenith
*The hi res color you've been promising yourself*

| | | |
|---|---|---|
| VDC-201301 | | $449.00 |

### 12" GREEN SCREEN - NEC
*20 MHz, P31 phosphor video monitor with audio*

| | | |
|---|---|---|
| VDM-651200 | *12" monitor* | $249.95 |

## Software

### CP/M 2.2 - Digital Research
*Latest & most powerful release of CP/M*

| | | |
|---|---|---|
| SFC-52506000D | *Manual set* | $24.95 |
| SFC-52506000M | *5¼" disk & manual* | $149.95 |
| SFC-52506000F | *8" disk & manual* | $149.95 |

### SDOS - SD Systems
*DOS, CBASIC-2, Z-80* assembler/editor/linker*

| | | |
|---|---|---|
| SFX-55001000D | *Manual set* | $24.95 |
| SFX-55001002M | *5¼" disks & man* | $199.95 |
| SFX-55001006F | *8" disk & manual* | $199.95 |

# December 31 of January 1, 1981

## Accessories for Apple

### 16K MEMORY UPGRADE
*Add 16K of RAM to your TRS-80, Apple, or Exidy*

**MEX-16100K** *TRS-80 kit* ............ **$39.95**
**MEX-16101K** *Apple kit* .............. **$39.95**
**MEX-16102K** *Exidy kit* .............. **$39.95**

### PRINTER INTERFACE - Cal Comp
*Centronics type I/O card w/ firmware*

**IOI-2041A** *A & T* .................... **$99.95**

### 8″ DRIVES for APPLE
*Controller, DOS, two 8″ drives, cabinet, & cable*

**Special package price** ............ **$1475.00**

### AIO - S.S.M.
*Parallel & serial interface for your Apple*

**IOI-2050K** *Kit* ...................... **$159.00**
**IOI-2050A** *A & T* .................. **$199.00**

### APPLE CLOCK - Cal Comp Sys
*Real time clock w/ battery back up*

**IOK-2100A** *A & T* ................ **$125.00**

### SUPERTALKER - Mtn Hardware
*Speech recognition synthesizer w/ speaker & mike*

**IOS-2015A** *A & T* ........ **$275.00**

### Z-80* CARD for APPLE
*Z-80* CPU card with CP/M for your Apple*

**CPX-30800A** *A & T* .............. **$289.00**

### MICROMODEM - D.C. Hayes
*Auto answer dial modem card for Apple or S 100*

**IOM-2010A** *Apple modem* ........ **$349.95**
**IOM-1100A** *S 100 modem* .......... **$375.00**

## Printers

### BASE 2 - Impact Printer
*132 cps, bi-directional, tractor feed, & graphics*

**PRM-13100** ....................... **$675.00**

### DP-9501 - Anadex
*9 x 11 dot matrix, 220 column, 200 cps, & graphics*

**PRM-10501** *Standard DP-9501* .... **$1495.00**
**PRM-10511** *with graphics & 2K* .. **$1595.00**

### SPINWRITER - NEC
*65 cps, bi-directional, letter quality with tractor*

**PRD-55510** *with 16K buffer* ...... **$2695.00**

### CENTRONICS 737-1
*9 x N dot matrix, letter quality, proportional spacing*

**PRM-15737** *Parallel* .............. **$795.00**
***With interface for Apple*** .......... **$895.00**

### NOVATION CAT
*300 baud, auto answer/originate acoustic modem*

**IOM-5200A** *Special sale price* ...... **$139.00**

*D-CAT 300 baud, direct connect modem*

**IOM-5201A** *Special sale price* ...... **$189.00**

### EPROM ERASERS
*L.S. Engineering UV eraser for up to 48 EPROMs*

**XME-3200** *A & T* ................... **$39.95**

*Spectronics hi intensity industrial eraser*

**XME-3100** *Without timer* ........... **$69.95**
**XME-3101** *With timer* ............... **$94.50**

### TV-1 - Best Buy
*The inexpensive alternative to video monitors*

**IOR-5040K** *Kit* ...................... **$8.95**

***Call for your free 1980 catalog***

## 8″ Disk Drive Sale

### DUAL DISK SUB—SYSTEM — Jade
*JADE's new dual disk sub-assemblies include: Handsome metal cabinet with proportionally balanced air flow system, rugged dual drive power supply, cooling fan, cable kit, lighted power switch, approved fuse assembly, line cord, Never-Mar rubber feet, and all necessary hardware to mount 2-8″ disk drives - it's all American made, guaranteed for six monthes, and it's in stock!*

Dual 8″ Sub-Assembly Cabinet

**END-000421** *Cabinet kit* .......... **$225.00**
**END-000420** *Bare cabinet* .......... **$59.95**

Single sided, double density disk drive sub-system

**END-000423** *Kit w/2 8″ drives* .... **$995.00**
**END-000424** *A & T w/2 8″ drives* **$1195.00**

Double sided, double density disk drive sub-system

**END-000426** *kit w/2 8″ drives* .... **$1495.00**
**END-000427** *A & T w/2 8″ drives* **$1695.00**

### 8″ DISK DRIVES
*Highly reliable double density floppy disk drives*

Shugart 801R single sided, double density

**MSF-10801R** *SA-801R* ............ **$425.00**
***Special Sale Price*** .......... ***2 for $800.00***

Siemens FDD100-8D2 single sided, double density

**MSF-201120** *6 mo warranty* ....... **$395.00**
***Special sale price*** ............ ***2 for $750.00***

Qume Datatrak 8 double sided, double density

**MSF-750080** *SA-851R compatible* .. **$625.00**
***Special sale price*** ........... ***2 for $1198.00***

### JADE DISK PACKAGE
*Double-D controller kit, two 8″ double density drives CP/M 2.2, cabinet, power supply, & cables*

**Special package price** ........... **$1395.00**

### DISKETTES - Jade
*Bargain prices on magnificent magnetic media*

5¼″ single sided, single density, box of 10

**MMD-5110103** *Soft sector* .......... **$27.95**
**MMD-5111003** *10 sector* ............ **$27.95**
**MMD-5111603** *16 sector* ............ **$27.95**

5¼″ double sided, double density, box of 10

**MMD-5220103** *Soft sector* .......... **$39.95**

8″ single sided, single density, box of 10

**MMD-8110103** *Soft sector* .......... **$33.95**

8″ single sided, double density, box of 10

**MMD-8120103** *Soft sector* .......... **$39.95**

8″ double sided, double density, box of 10

**MMD-8220103** *Soft sector* .......... **$57.95**

### FLOPPY SAVERS - Tri-Star
*Protect your valuable software from spindle damage*

**MMA-205** *5¼″ kit* .................... **$13.95**
**MMA-208** *8″ kit* ..................... **$15.95**

## Mainframes

### MAINFRAME - Cal Comp Sys
*12 slot S 100 mainframe with 20 amp power supply*

**ENC-112105** *Kit* ................. **$309.95**
**ENC-112106** *A & T* ................. **$349.95**

### DISK MAINFRAME - NNC
*Dual 8″ drive cutouts with 8 slot motherboard*

**ENS-112320** *with 30 amp p.s.* ..... **$699.95**

## *TRS-80 APPLE*
### 16K MEMORY UPGRADE KIT
## *$39.95*


**MICROPROCESSORS**

| | |
|---|---|
| Z-80 | 10.95 |
| Z-80A | 12.95 |
| 6502 | 11.50 |
| 6800 | 11.95 |
| 6802 | 17.95 |
| 6809 | 39.95 |
| 8035 | 24.00 |
| 8080A | 6.59 |
| 8085 | 15.95 |
| 8748 | 59.95 |

**SUPPORT DEVICES**

| | |
|---|---|
| 8212 | 4.95 |
| 8214 | 4.65 |
| 8216 | 2.95 |
| 8224 | 3.25 |
| 8224-4 | 10.95 |
| 8226 | 3.85 |
| 8228 | 4.95 |
| 8238 | 4.95 |
| 8243 | 8.00 |
| 8250 | 14.95 |
| 8251 | 6.50 |
| 8253 | 13.95 |
| 8255 | 6.50 |
| 8257 | 19.95 |
| 8259 | 17.95 |
| 8275 | 49.95 |
| 8279 | 15.95 |

**Z-80 SUPPORT**

| | |
|---|---|
| 3881 *PIO* | 9.50 |
| 3881-4 *PIO 4 MHz* | 14.50 |
| 3882 *CTC* | 9.50 |
| 3882-4 *CTC 4 MHz* | 14.95 |
| 3883 *SIO* | 29.50 |
| 3884 *SIO* | 49.50 |

**BAUD RATE GENERATORS**

| | |
|---|---|
| MC14411 | 10.00 |
| 1.843 MHz xtal | 4.95 |

**6800 SUPPORT**

| | |
|---|---|
| 6821P | 5.95 |
| 6828P | 11.95 |
| 6834P | 22.50 |
| 6840P | 18.75 |
| 6850P | 4.80 |
| 6852P | 5.79 |
| 6875L | 7.40 |
| 68488P | 25.00 |

**PROMS**

| | |
|---|---|
| 2708 *450ns* | 8.95 |
| 2716 *12.5v* | 14.95 |
| 2716 *5v* | 14.95 |
| 2732 *5v* | 59.95 |
| 2758 *5v* | 19.95 |

**UARTS**

| | |
|---|---|
| AY5-1013A | 5.25 |
| AY3-1014A | 8.25 |
| TR1602B | 5.25 |
| IM6402 | 9.00 |

**RAMS**

| | |
|---|---|
| 21L02 *2 MHz* | 1.25 |
| 21L02A *4 MHz* | 1.50 |
| 2114L *2 MHz* | 3.75 |
| 2114LA *4 MHz* | 3.95 |
| 2147 *70ns* | 39.95 |
| 4116 | 4.95 |
| 4164 *64K x1* | 175.00 |
| 5257 *2 MHz* | 6.75 |
| 5257A *4 MHz* | 7.25 |
| MK4118 | 18.95 |

**PLACE ORDERS TOLL FREE**

**Inside California** 800-262-1710
**Continental U.S.** 800-421-5500

For customer service or technical inquiries call 213-973-7707

*Write for our FREE 1980 catalog*

**JADE**
**COMPUTER PRODUCTS**
4901 W. Rosecrans, Hawthorne, CA 90250

**TERMS OF SALE:** Cash, checks, credit cards money orders or from recognized institutions Purchase orders accepted. Minimum order $10.00 California residents add 6% sales tax. Minimum shipping and handling charge $2.50. Prices are for U.S. and Canadian delivery only and are subject to change without notice. For export prices and information send for a **JADE INTERNATIONAL CATALOG.**

VISA · AMERICAN EXPRESS · master charge

48

## LIGHT PEN

Comes with Backgammon and Tic-Tac-Toe on tape with full documentation and program listing. Requires 9v. battery. Part No. IBEX $19.95

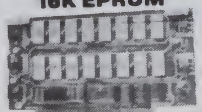
## APPLE II HOBBY/ CARD PROTOTYPING

Part No.7907 $14.95

## APPLE II PARALLEL INTERFACE

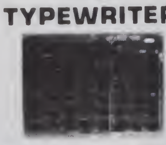
Interfaces printers, synthesizers keyboards, and JBE A-D D-A Converter and Switches • This interface has 4 I/O ports with handshaking logic, 2-6522 VIA's and a 74LS74 for timing • Inputs and outputs are TTL compatible • Assm. Part No. 79295A $69.95 • Kit Part No. 79295K $59.95

## 16K EPROM



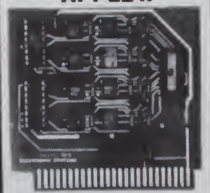
Uses 2708 EPROMS, memory speed selection provided, addressable anywhere in 65K of memory, can be shadowed in 4K increments. Board only $24.95 part no. 7902, with parts less EPROMs $49.95 part no. 7902A.

## T.V. TYPEWRITER



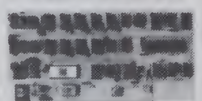
● Stand alone TVT ● 32 char/line, 16 lines, modifications for 64 char/line included ● Parallel ASCII (TTL) input ● Video output ● 1K on board memory ● Output for computer controlled curser ● Auto scroll ● Non-destructive curser ● Curser inputs: up, down, left, right, home, EOL, EOS ● Scroll up, down ● Requires +5 volts at 1.5 amps, and -12 volts at 30 mA ● All 7400, TTL chips ● Char. gen. 2513 ● Upper case only ● Board only $39.00 Part No. 106, with parts $145.00 Part No. 106A

## OPTO-ISOLATED PARALLEL INPUT BOARD FOR APPLE II



There are 8 inputs that can be driven from TTL logic or any 5 volt source. The circuit board can be plugged into any of the 8 sockets of your Apple II. It has a 16 pin socket for standard dip ribbon cable connection. Board only $15.00. Part No. 120, with parts $69.95. Part No. 120A.

## VIDEO TERMINAL



16 lines, 64 columns • Upper and lower case • 5x7 dot matrix • Serial RS-232 in and out with TTL parallel keyboard input • On board baud rate generator 75, 110, 150, 300, 600, & 1200 jumper selectable • Memory 1024 characters (7-21L02) • Video processor chip SFF96364 by Neculonic • Control characters (CR, LF, →, ←, ↑, ↓, non destructive cursor, CS, home, CL • White characters on black background or vice-versa • With the addition of a keyboard, video monitor or TV set with TV interface (part no. 107A) and power supply this is a complete stand alone terminal • also S-100 compatible • requires +16, & -16 VDC at 100mA, and 8VDC at 1A. Part No. 1000A $199.95 kit.

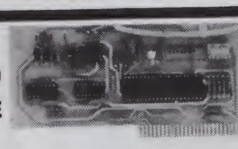
## RS-232/TTL INTERFACE

● Converts TTL to RS-232, and converts RS-232 to TTL ● Two separate circuits ● Requires -12 and +12 volts ● All connections go to a 10 pin edge connector, kit $9.95 Part No.232A 10 Pin edge connector $3.00 part No. 10P.

## PARALLEL TRIAC OUTPUT BOARD FOR APPLE II

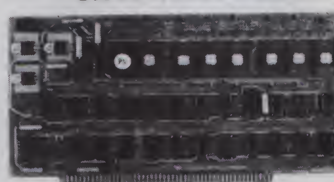
This board has 8 triacs capable of switching 110 volt 6 amp loads (660 watts per channel) or a total of 5280 watts. Board only $15.00 Part No. 210, with parts $119.95 Part No. 210A

## APPLE II* SERIAL I/O INTERFACE



Baud rate is continuously adjustable from 0 to 30,000 ● Plugs into any peripheral connector ● Low current drain. RS-232 input and output ● On board switch selectable 5 to 8 data bits, 1 or 2 stop bits, and parity or no parity either odd or even ● Jumper selectable address ● SOFTWARE ● Input and Output routine from monitor or BASIC to teletype or other serial printer ● Program for using an Apple II for a video or an intelligent terminal. Also can output in correspondence code to interface with some selectrics. ● Also watches DTR ● Board only $15.00 Part No. 2, with parts $42.00 Part No. 2A, assembled $62.00 Part No. 2C

## 8K EPROM PICEON



● Programs 2708's address relocation of each 4K of memory to any 4K boundary ● Power on jump and reset jump option for "turnkey" systems and computers without a front panel ● Program saver software in 1 2708 EPROM $25. Bare board $35 including custom coil, board with parts but no EPROMS $139, with 4 EPROMS $179, with 8 EPROMS $219.

## SPINWRITER MODELS 5510 and 5520

Features—EIA RS-232C/CCITT V.24 Interface Standard • 55 Characters Per Second Maximum Print Rate • Impeccable Print Quality (OCR Quality) • Microprocessor Electronics • High Resolution Plotting/Graphing • Lowest Operating Noise Level • Self-Test Printing • Operator Engineered Control Panel • Prints Original and up to Seven Copies • NEC Information Systems new Model 5510 Receive Only and Model 5520 Keyboard Send/Receive SPINWRITER terminals are microprocessor controlled serial, impact terminals designed for remote printing applications where impeccable print quality is required. Model 5510 RO, Part No. NECA30759 $2795.95 • Model 5520 KSR, Part No. NECA30762 $3095.95

## DC POWER SUPPLY

• Board supplies a regulated +5 volts at 3 amps., +12, -12, and -5 volts at 1 amp. • Power required is 8 volts AC at 3 amps., and 24 volts AC C.T. at 1.5 amps. • Board only $12.50 Part No. 6085, with parts excluding transformers $42.50 Part No. 6085A

## TIDMA

Tape Interface Direct Memory Access ● Record and play programs without bootstrap loader (no prom) has FSK encoder/decoder for direct connections to low cost recorder at 1200 baud rate, and direct connections for inputs and outputs to a digital recorder at any baud rate ● S-100 bus compatible ● Board only $35.00 Part No. 112, with parts $110.00 Part No. 112A.

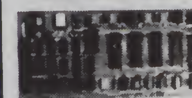
## SYSTEM MONITOR

8080, 8085, or Z-80 System monitor for use with the TIDMA board. There is no need for the front panel. Complete with documentation $12.95.

## RS-232/TTY INTERFACE


This board has two active circuits, one converts RS-232 to 20 mA, the other converts 20 mA to RS-232. Requires +12 and -12 volts. $9.95 Part No. 600A Kit.

## SERIAL I/O



Four Serial I/O RS-232 ports. S-100 Bus, Software or jumper selectable baud rate (110, 300, 600, 1200, 2400, 4800, 9600, 19.2K), on board Xtal baud rate generator, Addressing, switch selectable, Parity or no parity (odd or even) switch selectable, 1 or 2 stop bits, 5 to 8 bits/character. Board only $29.95, Part No. 7908. With parts (kit) $199.95, Part No. 7908A.

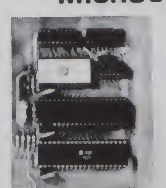
## S-100 BUS ACTIVE TERMINATOR

Board only $14.95 Part No. 900, with parts $24.95 Part No. 900A

## 5 VOLT POWER SUPPLY


This 2¼x2½" 5V 500MA power supply is protected against short circuit and thermal breakdown and uses a wall transformer for safety • It operates JBE A-D and D-A converter, 8085 computer, 8088 computer and 6502 micro-microcomputer • Documentation is included. • Assm. Part No. 80160A $20.95 • Kit Part No. 80160K $16.95 • Bare Board $8.95

## 6502 MICRO-MICROCOMPUTER



Microcomputer has the following: • 1024 Bytes of RAM (two 2114s) • 2048 Bytes of EPROM (2716) • Uses one 6522 via (documentation inc.) • 2 8-bit bidirectional I/O ports • 2 16-bit programmable timer/counters • Serial Data Port • Latched output and input with handshaking logic • TTL and CMOS compatible • The 6502 Microprocessor is particularly suited for control functions such as temperature control, burglar alarm, electric wheelchair, lights, etc. • This Micro-Micro interfaces with the JBE Solid State Switch and A-D and D-A Converter and uses the JBE 5V power supply (see below) • 2716 EPROM is available separately (not included in kit or assm. board) • A 50 pin connector is included • Assm. Part No. 80153A $110.95 • Kit Part No. 80153K $89.95.

To Order:


HEX ENCODED KEYBOARD
Four onboard LEDs indicate the HEX code generated for each key depression. The board requires a single +5 volt supply. Board only $15.00 Part No. HEX-3, with parts $49.95 Part No. HEX- 3A. 44 pin edge connector $4.00 Part No. 44P.
SOLID STATE SWITCH
Your computer can control power (120VAC) to your printer, lights, and other 120 VAC appliances up to 720 watts (6AMPs at 120VAC) • Input 3 to 15 VDC, 2-13 MA TTL compatible, isolation 1500V
• 1 Channel Assm. Part No. 79282A1 $13.95
• 1 Channel Kit Part No. 79282K1 $10.95
• 4 Channel Assm. Part No. 79282A4 $49.95
• 4 Channel Kit Part No. 79282K4 $39.95
TAPE INTERFACE
• Converts a low cost tape recorder to a digital recorder • Works up to 1200 baud • Digital in and out are TTL-serial • Output of board connects to mic. in of recorder • Earphone of recorder connects to input on board • No coils • Requires +5 volts, low power drain • Board only $7.60 Part No. 111, with parts $29.95 Part No. 111A
HIGH VOLTAGE TRANSIENT ELIMINATOR
Detects and shunts voltage transients in less than one nanosecond • Rated energy dissipation of 600,000 watts up to 100 microseconds • Plugs into any standard 120-volt outlet for immediate protection. • Part No. RK120 $85.00
T.V. INTERFACE
• Converts video to AM modulated RF, Channels 2 or 3. So powerful almost no tuning is required. On board regulated power supply makes this extremely stable. Rated very highly in Doctor Dobbs' Journal. Recommended by Apple • Power required is 12 volts AC C.T., or +5 volts DC • Board only $7.60 part No. 107, with parts $13.50 Part No. 107A
UART & BAUD RATE GENERATOR
• Converts serial to parallel and parallel to serial • Low cost on board baud rate generator • Baud rates: 110, 150, 300, 600, 1200, and 2400 • Low power drain +5 volts and -12 volts required • TTL compatible • All characters contain a start bit, 5 to 8 data bits, 1 or 2 stop bits, and either odd or even parity. • All connections go to a 44 pin gold plated edge connector • Board only $12.00 Part No. 101, with parts $35.00 Part No. 101A, 44 pin edge connector $4.00 Part No. 44P
A-to-D D-to-A CONVERTER
• Analog to Digital Digital to Analog Converter • A-D conversion time 20us • D-A conversion 5us • Uses include speech and music synthesizing and slow scan TV • Single power supply (5V), 8 Bits wide, latched I/O, strobe lines • Assm. Part No. 79287A $79.95 • Kit Part No. 79287K $59.95
MODEM
• Type 103 • Full or half duplex • Works up to 300 baud • Originate or Answer • Serial TTL input and output • connect 8 Ω speaker and crystal mic. directly to board • Requires +5 volts • Board only $7.60 Part No. 109, with parts $29.95 Part No. 109A.
DIMMER CONTROL
The JBE Dimmer Control has 4 channels, 256 brightness levels, on-board power supply and four 8-bit parallel input ports (not latched) • This board interfaces with the JBE Solid State Switch and Apple II Parallel Interface Card (documentation incl.) • Assm. Part No. 80146A $89.95 • Kit Part No. 80146K $79.95
DECWRITER GRAPHICS BOARD
Low cost graphics hardcopy? Add GRAPHICS II to your DECwriter! GRAPHICS II makes the DECwriter II a digital printer plotter with bidirectional paper feed, built in vector generator and 100 x 72 DPI resolution • Includes APL and RAM characters, bold and double size type, tabs, RS 232 and CL I/F's, 1000 character buffer and more • Can be used with any computer • Installs in minutes • Great for science, engineering, business graphics • Part No. 217900 $995.00 • Bidirectional tractor feed Part No. G3000 $65.00
44 BUS MOTHER BOARD
Has provisions for ten 44 pin (.156) connectors, spaced 3/4 of an inch apart. Pin 20 is connected to X, and 22 is connected to Z for power and ground. All the other pins are connected in parallel. This board also has provisions for bypass capacitors. Board cost $15.00 Part No. 102. Connectors $3.00 each Part No. 44WP.
RS-232/20mA INTERFACE
This board has two passive, opto-isolated circuits. One converts RS-232 to 20mA, the other converts 20mA to RS-232. All connections go to a 10 pin edge connector. Requires +12 and -12 volts. Board only $9.95, part no. 7901, with parts $14.95 Part No. 7901A.
DIGICOM DATA PRODUCTS INC. Series 312 Acoustic Coupler
300 BAUD Originate, Part No. AC3122, $219.95. 300 BAUD Answer, Part No. AC3122, $219.95. 300 BAUD Answer/Originate, Part No. AC3123, $229.95.
COMPUCRUISE
$129.95; with cruise control $169.95
16K RAMS
For the Apple, TRS-80 or Pet $8 each Part No. 4116/2117.
±12 VOLT POWER SUPPLY
This 2x2½" power supply uses a wall transformer for safety and is protected against short circuit and thermal breakdown • It is rated at ± 12V 120MA and can be used as a single 24V power supply at 120 MA • It is ideally suited to operational amplifier experiments • Assm. Part No. 80161A $22.95 • Kit Part No. 80161K $18.95
SUPER MODEM
Orignate, RS-232 and 20 mA compatable, Full duplex, and half duplex, direct connect or acoustic coupled, on board power supply, carrier detect light, DB25 plug, 300 BAUD, Type 103 compatable frequencies, Bare board Part No. 2000, $19,95, Kit Part No. 2000A, $99.95.
Send for FREE Catalog...a big self addressed envelope with 80¢ postage gets it fastest!
To Order: Mention part no., description, and price. In USA shipping paid by us for orders accompanied by check or money order. We accept C.O.D. orders (U.S. only) or a VISA or Master Charge no., expiration date, signature and phone no., shipping charges will be added. CA residents add 6.5% for tax. Outside USA add 15% for air mail postage and handling. Payment must be in U.S. dollars. Dealer inquiries invited. Prices subject to change without notice.
VISA
Order Line: (408) 448-0800
ELECTRONIC SYSTEMS Dept. KB, P.O. Box 21638, San Jose, CA USA 95151

# Power Supplies! Power Supplies! Power Supplies! SOLID STATE!! (5)

# We got 'em! Take your pick . . .

These units are ideal for micro computers. They have been removed from equipment, checked out and guaranteed.

1—5 volts @ 8 amps + 12 volts @ 2 amps + 6 volts @ 75 MA. Power supply has a 3-wire line cord and fused. Dimensions: 10½" × 5½" × 4½". Shipping weight: 16 lbs. .......... 37.50 ea. 2/70.00

2—Model 818, 5 volts at 15 amps + 12 volts at 4 amps-12 volts at 2 amps. (with line cord). .......... 35.00 ea. 2/65.00

3— + 5 volts at 5 amps ± 12 volts at 500 ma. + 6 volts at 25 ms. (line cord included). .......... 32.95 ea. 2/60.00

4—Elexon, multi output. Input: 120/240 AC, ±10%, 47–63 hz; output: 1) 12V, 1.5A, DC, OVP; 2) 12V, 1.5A, D.C., OVP. New, in box with operating instructions. .......... 31.50

5—Power Design, Model 1210, constant voltage, DC. P.S. input: 105–125 A.C., 55 to 440 hz. Output: 1-12 volts, 0-10 amps, DC. continuously adjustable output voltage and current limiting. ...... 139.00

## COMPUTER GRADE CAPACITORS . . .

| | | | | | |
|---|---|---|---|---|---|
| 18,000 mfd 10 VDC | 1.25 | 11,000 mfd 25 VDC | 1.50 | 4,000 mfd 75 VDC | 1.75 |
| 4,400 mfd 20 VDC | 1.00 | 35,000 mfd 35 VDC | 3.50 | 1,000 mfd 100 VDC | 1.00 |
| 46,000 mfd 20 VDC | 2.50 | 10,000 mfd 50 VDC | 2.50 | 6,800 mfd 100 VDC | 3.50 |
| 3.000 mfd 25 VDC | 1.00 | 22,000 mfd 60 VDC | 3.75 | 4,700 mfd 150 VDC | 3.75 |

## WIRE WRAP BOARDS

These boards are pre-wired and removed from equipment. Easy to unwrap for setting up your own board, contains mostly 14-pin IC sockets with individual pin connections. Each board has VCC and ground planes.

Smaller board measures 6½" × 6" and has 40 to 50 sockets. **Reduced prices** **$7.50 ea. 2/$14.00**

Larger board measures 13½" × 6" and has 75 to 100 sockets. **$12.50 ea. 2/$23.00**

## DIABLO System Disc Drive

SERIES 40, MODEL 43

100 tracks per inch, total capacity of 50 megabits, w/Model 429 power supply, sector counter, 24 sectors, 1 fixed disc, 1 removable disc, average access time 38 ms, PPM: 2600, dimensions: 10 5/16" high, fits in standard rack, equipped with full extension slides, excellent used condition. Shipped freight collect.

**$2495**

HEWLETT PACKARD model 200CD/rack mounted AUDIO OSCILLATOR freq:5hz to 600khz output: 160mw $165.00

HEWLETT PACKARD model 400D ANALOG VACUUM TUBE VOLTMETER freq: 10hz to 4mhz voltmeter range: 1mv to 300vac in 12 ranges $85.00

## TRANSFORMERS

ISOLATION STEP-DOWN TYPE

Primary: 230/115V, 50/60 CPS, Secondary: 115 volts output 250 VA.

**$13.95** EACH

## IMC MAGNETICS SUPER BOXER FANS

Unused, Model WS2107FL—310, 220/240 VAC, .3 amps, 50/60 hz, 4 11/16" × 4 11/16" × 1 1/2"

**$8.95**

Clock Crystal Oscillators—TTL, Vectron, type CO-231T. Crystal freq. 4.9152 mhz. Input voltage 5 VDC ±. Output: Drives 10 TTL Loads Logic "0": 0.4V max., sink 16ma. Logic "1" 2.4V min source 2 ma. (above 50 mhz drives 2 Schottky TTL loads). Tuning adjust. with nominal range of ±30 ppm below 25 mhz and 15 ppm above 25 mhz. R.F.E. 1½" × 1½" × ½" .......... $13.95

## SG-132 SWEEP SIGNAL GENE... OR

FREQ: 15 TO 400 M...

Output: AM & FM: CW ... at any frequency. Crysta... ...mhz or ±10B. Frequency ac... oscilloscope for observing waveforms.

**SOLD OUT**

**$329**

## TRENDLINE PHONES

Manufactured by I.T.T.

These units have rotary dials. Colors are: white, black, red, and green. They are packaged and have 6-foot cord and installation instructions. Used, but in good operating condition.

**34.50** WALL TYPE

Minimum order $25.00. Items offered subject to prior sale. FOB, Brockton, Mass. Money order or check w/order. Shipments and handling add 5%. Shipments by parcel post or UPS. No CODs. Mass. residents add 5% sales tax.

# WALLEN

ELECTRONICS CO. INC. Tel: (617) 588-6440-6441
✓45 108 SAWTELL AVE., BROCKTON, MA. 02402

ELECTRONIC COMPONENTS
TEST EQUIPMENT
CONNECTORS—WIRE

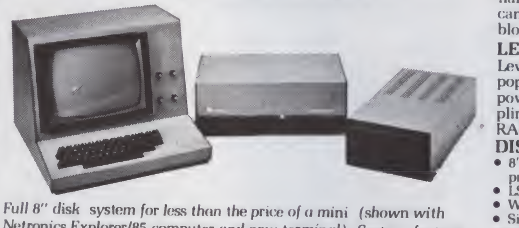
*Start learning and computing for only* ***$129.95*** *with a Netronics 8085-based computer kit. Then expand it in low-cost steps to a business/development system with 64k or more RAM, 8" floppy disk drives, hard disks and multi-terminal I/O.*

# THE NEW EXPLORER/85 SYSTEM

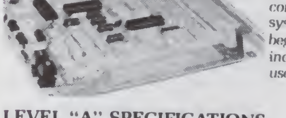
## Special! *Full 8" floppy, 64k system for less than the price of a mini! Only* $1499.95!

(Also available wired & tested, $1799.95)

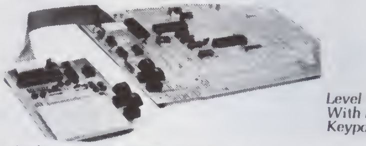
Imagine — for only $129.95 you can own the starting level of Explorer/85, a computer that's expandable into full business/development capabilities — a computer that can be your beginner system, an OEM controller, or an IBM-formatted 8" disk small business system. From the first day you own Explorer/85, you begin computing on a significant level, and applying principles discussed in leading computer magazines. Explorer/85 features the advanced Intel 8085 cpu, which is 100% compatible with the older 8080A. It offers onboard S-100 bus expansion, Microsoft BASIC in ROM, plus instant conversion to mass storage disk memory with standard IBM-formatted 8" disks. All for only $129.95, plus the cost of power supply, keyboard/terminal and RF modulator if you don't have them (see our remarkable prices below for these and other accessories). With a Hex Keypad/display front panel, Level "A" can be programmed with no need for a terminal, ideal for a controller, OEM, or a real low-cost start.



*Full 8" disk system for less than the price of a mini (shown with Netronics Explorer/85 computer and new terminal). System features floppy drive from Control Data Corp., world's largest maker of memory storage systems (not a hobby brand!)*



*Level "A" is a complete operating system, perfect for beginners, hobbyists, industrial controller use. $129.95*



*Level "A" With Hex Keypad/Display.*

### LEVEL "A" SPECIFICATIONS

Explorer/85's Level "A" system features the advanced Intel 8085 cpu, an 8355 ROM with 2k deluxe monitor/operating system, and an advanced 8155 RAM I/O . . . all on a single motherboard with room for RAM/ROM/PROM/EPROM and S-100 expansion, plus generous prototyping space.

**PC Board:** Glass epoxy, plated through holes with solder mask. • **I/O:** Provisions for 25-pin (DB25) connector for terminal serial I/O, which can also support a paper tape reader . . . cassette tape recorder input and output . . . cassette tape control output . . . LED output indicator on SOD (serial output) line . . . printer interface (less drivers) . . . total of four 8-bit plus one 6-bit I/O ports. • **Crystal Frequency:** 6.144 MHz. • **Control Switches:** Reset and user (RST 7.5) interrupt . . . additional provisions for RST 5.5, 6.5 and TRAP interrupts onboard. • **Counter/Timer:** Programmable, 14-bit binary. • **System RAM:** 256 bytes located at F800, ideal for smaller systems and for use as an isolated stack area in expanded systems . . . RAM expandable to 64K via S-100 bus or 4k on motherboard.

**System Monitor (Terminal Version):** 2k bytes of deluxe system monitor ROM located at F000, leaving 0000 free for user RAM/ROM. Features include tape load with labeling . . . examine/change contents of memory . . . insert data . . . warm start . . . examine and change all registers . . . single step with register display at each break point, a debugging/training feature . . . go to execution address . . . move blocks of memory from one location to another . . . fill blocks of memory with a constant . . . display blocks of memory . . . automatic baud rate selection to 9600 baud . . . variable display line length control (1-255 characters/line) . . . channelized I/O monitor routine with 8-bit parallel output for high-speed printer . . . serial console in and console out channel so that monitor can communicate with I/O ports.

**System Monitor (Hex Keypad/Display Version):** Tape load with labeling . . . tape dump with labeling . . . examine/change contents of memory . . . insert data . . . warm start . . . examine and change all registers . . . single step with register display at each break point . . . go to execution address. Level "A" in this version makes a perfect controller for industrial applications, and is programmed using the Netronics Hex Keypad/Display. It is low cost, perfect for beginners.

### HEX KEYPAD/DISPLAY SPECIFICATIONS

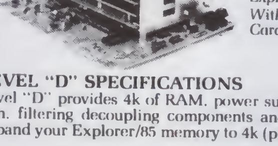
Calculator type keypad with 24 system-defined and 16 user-defined keys. Six digit calculator-type display, that displays full address plus data as well as register and status information.

### LEVEL "B" SPECIFICATIONS

Level "B" provides the S-100 signals plus buffers/drivers to support up to six S-100 bus boards, and includes: address decoding for onboard 4k RAM expansion selectable in 4k blocks . . . address decoding for onboard 8k EPROM expansion selectable in 8k blocks . . . address and data bus drivers for onboard expansion . . . wait state generator (jumper selectable), to allow the use of slower memories . . . two separate 5 volt regulators.

### LEVEL "C" SPECIFICATIONS

Level "C" expands Explorer/85's motherboard with a card cage, allowing you to plug up to six S-100 cards directly into the motherboard. Both cage and card are neatly contained inside Explorer's deluxe steel cabinet. Level "C" includes a sheet metal superstructure, a 5-card, gold plated S-100 extension PC board that plugs into the motherboard. Just add required number of S-100 connectors.



*Explorer/85 With Level "C" Card Cage.*

### LEVEL "D" SPECIFICATIONS

Level "D" provides 4k of RAM, power supply regulation, filtering decoupling components and sockets to expand your Explorer/85 memory to 4k (plus the original 256 bytes located in the 8155A). The static RAM can be located anywhere from 0000 to EFFF in 4k blocks.

### LEVEL "E" SPECIFICATIONS

Level "E" adds sockets for 8k of EPROM to use the popular Intel 2716 or the TI 2516. It includes all sockets, power supply regulator, heat sink, filtering and decoupling components. Sockets may also be used for 2k x 8 RAM IC's (allowing for up to 12k of onboard RAM).

### DISK DRIVE SPECIFICATIONS

- 8" CONTROL DATA CORP. professional drive.
- LSI controller.
- Write protect.
- Single or double density.
- Data capacity: 401,016 bytes (SD), 802,032 bytes (DD), unformatted.
- Access time: 25ms (one track).

### DISK CONTROLLER/ I/O BOARD SPECIFICATIONS

- Controls up to four 8" drives.
- 1771A LSI (SD) floppy disk controller.
- Onboard data separator (IBM compatible).
- 2 Serial I/O ports
- Autoboot to disk system when system reset.
- 2716 PROM socket included for use in custom applications.
- Onboard crystal controlled.
- Onboard I/O baud rate generators to 9600 baud.
- Double-sided PC board (glass epoxy.)

### DISK DRIVE CABINET/POWER SUPPLY

- Deluxe steel cabinet with individual power supply for maximum reliability and stability.

## ORDER A COORDINATED EXPLORER/85 APPLICATIONS PAK!

**Beginner's Pak (Save $26.00!)** — Buy Level "A" (Terminal Version) with Monitor Source Listing and AP-1 5-amp Power Supply: (regular price $199.95), now at SPECIAL PRICE: **$169.95** plus post. & insur.

**Experimenter's Pak II (Save $53.40!)** — Buy Level "A" (Hex Keypad/Display Version) with Hex Keypad/Display, Intel 8085 User Manual, Level "A" Hex Monitor Source Listing, and AP-1 5-amp Power Supply: (regular price $279.35), all at SPECIAL PRICE: **$219.95** plus post. & insur.

**Special Microsoft BASIC Pak (Save $103.00!)** — Includes Level "A" (Terminal Version), Level "B", Level "D" (4k RAM), Level "E", 8k Microsoft in ROM, Intel 8085 User Manual, Level "A" Monitor Source Listing, and AP-1 5-amp Power Supply: (regular price $439.70), now yours at SPECIAL PRICE: **$329.95** plus post. & insur.

**ADD A TERMINAL WITH CABINET, GET A FREE RF MODULATOR:** Save over $114 at this SPECIAL PRICE: **$499.95** plus post. & insur.

**Special 8" Disk Edition Explorer/85 (Save over $104!)** — Includes disk-version Level "A", Level "B", two S-100 connectors and brackets, disk controller, 64k RAM, AP-1 5-amp power supply, Explorer/85 deluxe steel cabinet, cabinet fan, 8" SD/DD disk drive from famous CONTROL DATA CORP. (not a hobby brand!), drive cabinet with power supply, and drive cable set-up for two drives. This package includes everything but terminal and printers (see coupon for them). Regular price $1630.30, all yours in kit at SPECIAL PRICE: **$1499.95** plus post. & insur. Wired and tested, only **$1799.95.**

**Special! Complete Business Software Pak (Save $625.00!)** — Includes CP/M 2.0, Microsoft BASIC, General Ledger, Accounts Receivable, Accounts Payable, Payroll Package: (regular price $1325), yours now at SPECIAL PRICE: **$699.95.**

*Please send the items checked below:*

- ☐ **Explorer/85 Level "A" kit** (Terminal Version) . . . **$129.95** plus $3 post. & insur.
- ☐ **Explorer/85 Level "A" kit** (Hex Keypad/Display Version) . . . **$129.95** plus $3 post. & insur.
- ☐ **8k Microsoft BASIC** on cassette tape, **$64.95** postpaid.
- ☐ **8k Microsoft BASIC in ROM kit** (requires Levels "B", "D" and "E") . . . **$99.95** plus $2 post. & insur.
- ☐ **Level "B" (S-100) kit** . . . **$49.95** plus $2 post. & insur.
- ☐ **Level "C" (S-100 6-card expander) kit** . . . **$39.95** plus $2 post. & insur.
- ☐ **Level "D" (4k RAM) kit** . . . **$69.95** plus $2 post. & insur.
- ☐ **Level "E" (EPROM/ROM) kit** . . . **$5.95** plus 50¢ p&h.
- ☐ **Deluxe Steel Cabinet** for Explorer/85 . . . **$49.95** plus $3 post. & insur.
  - ☐ Fan For Cabinet . . . **$15.00** plus $1.50 post. & insur.
- ☐ **ASCII Keyboard/Computer Terminal kit:** features a full 128 character set, u&l case; full cursor control; 75 ohm video output; convertible to baudot output; selectable baud rate, RS232-C or 20 ma. I/O, 32 or 64 character by 16 line formats, and can be used with either a CRT monitor or a TV set (if you have an RF modulator) . . . **$149.95** plus $3.00 post. & insur.
  - ☐ **DeLuxe Steel Cabinet** for ASCII keyboard/terminal . . . **$19.95** plus $2.50 post. & insur.
- ☐ **New! Terminal/Monitor:** (See photo) Same features as above, except 12" monitor with keyboard and terminal is in deluxe single cabinet; kit . . . **$399.95** plus $7 post. & insur.
- ☐ **Hazeltine terminals:** Our prices too low to quote — **CALL US**
- ☐ **Lear-Sigler terminals/printers:** Our prices too low to quote: **CALL US**
- ☐ **Hex Keypad/Display kit** . . . **$69.95** plus $2 post. & insur.
- ☐ **AP-1 Power Supply Kit** ±8V @ 5 amps) in deluxe steel cabinet . . . **$39.95** plus $2 post. & insur.
- ☐ **Gold Plated S-100 Bus Connectors** . . . **$4.85** each, postpaid.
- ☐ **RF Modulator kit** (allows you to use your TV set as a monitor) . . . $8.95 **postpaid.**
- ☐ **16k RAM kit** (S-100 board expands to 64k) . . . **$199.95** plus $2 post. & insur.
- ☐ **32k RAM kit** . . . **$299.95** plus $2 post. & insur.
- ☐ **48k RAM kit** . . . **$399.95** plus $2 post. & insur.
- ☐ **64k RAM kit** . . . **$499.95** plus $2 post. & insur.
- ☐ **16k RAM Expansion kit** (to expand any of the above in 16k blocks up to 64k) . . . **$99.95** plus $2 post. & insur. each.
- ☐ **Intel 8085 cpu Users' Manual** . . . **$7.50** postpaid.
- ☐ **12" Video Monitor** (10MHz bandwidth) . . . **$139.95** plus $5 post. & insur.
- ☐ **Beginner's Pak** (see above) **$169.95** plus $4 post. & insur.
- ☐ **Experimenter's Pak** (see above) . . . **$219.95** plus $6 post. & insur.
- ☐ **Special Microsoft BASIC Pak Without Terminal** (see above) . . . **$329.95** plus $7 post. & insur.
- ☐ Same as above, plus **ASCII Keyboard Terminal With Cabinet, Get Free RF Modulator** (see above) . . . **$499.95** plus $10 post. & insur.
- ☐ **Special 8" Disk Edition Explorer/85** (see above) . . . **$1499.95** plus $26 post. & insur.
  - ☐ **Wired & Tested** . . . **$1799.95** plus $26 post. & insur.
- ☐ **Extra 8" CDC Floppy Drives** . . . **$499.95** plus $12 post. & insur.
  - ☐ **Cabinet & Power Supply For Drive** . . . **$69.95** plus $3 post. & insur.
- ☐ **Drive Cable Set-up For Two Drives** . . . **$25** plus $1.50 post. & insur.
- ☐ **Disk Controller Board With I/O Ports** . . . **$199.95** plus $2 post. & insur.
- ☐ **Special: Complete Business Software Pak** (see above) . . . **$699.96** postpaid.
  - SOLD SEPARATELY:
  - ☐ **CP/M 1.4** . . . **$100** postpaid.
  - ☐ **CP/M 2.0** . . . **$150** postpaid.
  - ☐ **Microsoft BASIC** . . . **$325** postpaid.
- ☐ **Intel 8085 cpu User Manual** . . . $7.50 **postpaid.**
- ☐ **Level "A" Monitor Source Listing** . . . **$25** postpaid.

Dept. K12

**Continental U.S.A. Credit Card Buyers Outside Connecticut**

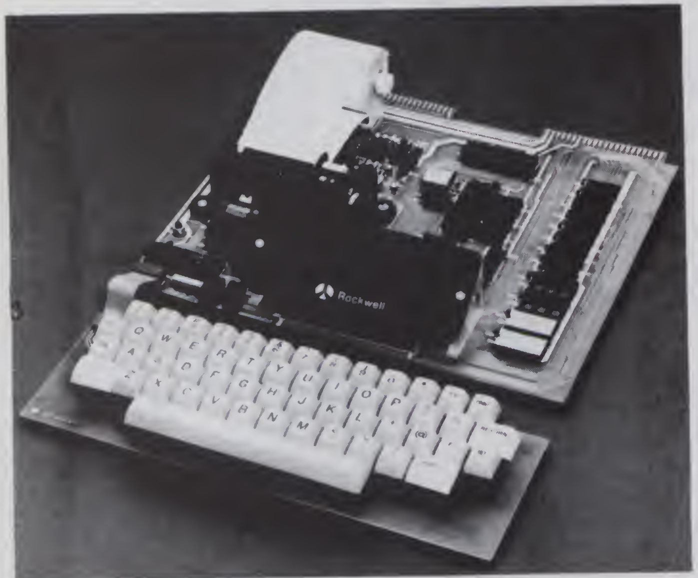
**CALL TOLL FREE: 800-243-7428**

To Order From Connecticut Or For Technical Assistance, call (203) 354-9375

Total Enclosed (Conn res. add sales tax) $ ______
Paid By:
☐ Personal Check ☐ *Cashier's Check/Money Order*
☐ VISA ☐ Master Charge (Bank No. _ _ _ _)
Acct. No. ______________ Exp. Date ______
Signature ______________
Print
Name ______________
Address ______________
City______________
State ______________ Zip______________

**NETRONICS Research & Development Ltd.**
**333 Litchfield Road, New Milford, CT 06776**

# AIM 65 BY ROCKWELL INTERNATIONAL




AIM 65 is fully assembled, tested and warranted. With the addition of a low cost, readily available power supply, it's ready to start working for you.

AIM 65 features on-board thermal printer and alphanumeric display, and a terminal-style keyboard. It has an addressing capability up to 65K bytes, and comes with a user-dedicated 1K or 4K RAM. Two installed 4K ROMS hold a powerful Advanced Interface Monitor program, and three spare sockets are included to expand on-board ROM or PROM up to 20K bytes.

An Application Connector provides for attaching a TTY and one or two audio cassette recorders, and gives external access to the user-dedicated general purpose I/O lines.

Also included as standard are a comprehensive AIM 65 User's Manual, a handy pocket reference card, an R6500 Hardware Manual, an R6500 Programming Manual and an AIM 65 schematic.

AIM 65 is packaged on two compact modules. The circuit module is 12 inches wide and 10 inches long, the keyboard module is 12 inches wide and 4 inches long. They are connected by a detachable cable.

### THERMAL PRINTER
Most desired feature on low-cost microcomputer systems . . .
- Wide 20-column printout
- Versatile 5 x 7 dot matrix format
- Complete 64-character ASCII alphanumeric format
- Fast 120 lines per minute
- Quite thermal operation
- Proven reliability

### FULL-SIZE ALPHANUMERIC KEYBOARD
Provides compatibility with system terminals . . .
- Standard 54 key, terminal-style layout
- 26 alphabetic characters
- 10 numeric characters
- 22 special characters
- 9 control functions
- 3 user-defined functions

### TRUE ALPHANUMERIC DISPLAY
Provides legible and lengthy display . . .
- 20 characters wide
- 16-segment characters
- High contrast monolithic characters
- Complete 64-character ASCII alphanumeric format

### PROVEN R6500 MICROCOMPUTER SYSTEM DEVICES
Reliable, high performance NMOS technology . . .
- R6502 Central Processing Unit (CPU), operating at 1 MHz. Has 65K address capability, 13 addressing modes and true index capability. Simple but powerful 56 instructions.
- Read/Write Memory, using R2114 Static RAM devices. Available in 1K byte and 4K byte versions.
- 8K Monitor Program Memory, using R2332 Static ROM devices. Has sockets to accept additional 2332 ROM or 2532 PROM devices, to expand on-board Program memory up to 20K bytes.
- R6532 RAM-Input/Output-Timer (RIOT) combination device. Multipurpose circuit for AIM 65 Monitor functions.
- Two R6522 Versatile Interface Adapter (VIA) devices, which support AIM 65 and user functions. Each VIA has two parallel and one serial 8-bit, bidirectional I/O ports, two 2-bit peripheral handshake control lines and two fully-programmable 16-bit interval timer/event counters.

### BUILT-IN EXPANSION CAPABILITY
- 44-Pin Application Connector for peripheral add-ons
- 44-Pin Expansion Connector has full system bus
- Both connectors are KIM-1 compatible

### TTY AND AUDIO CASSETTE INTERFACES
Standard interface to low-cost peripherals . . .
- 20 ma. current loop TTY interface
- Interface for two audio cassette recorders
- Two audio cassette formats: ASCII KIM-1 compatible and binary, blocked file assembler compatible

### ROM RESIDENT ADVANCED INTERACTIVE MONITOR
Advanced features found only on larger systems . . .
- Monitor-generated prompts
- Single keystroke commands
- Address independent data entry
- Debug aids
- Error messages
- Option and user interface linkage

### ADVANCED INTERACTIVE MONITOR COMMANDS
- Major Function Entry
- Instruction Entry and Disassembly
- Display/Alter Registers and Memory
- Manipulate Breakpoints
- Control Instruction/Trace
- Control Peripheral Devices
- Call User-Defined Functions
- Comprehensive Text Editor

### LOW COST PLUG-IN ROM OPTIONS
- 4K Assembler—symbolic, two-pass , A65-010 $79.00
- 8K BASIC Interpreter A65-020 $99.00

### POWER SUPPLY SPECIFICATIONS
- +5 VDC ± 5% regulated @ 2.0 amps (max)
- +24 VDC ± 15% unregulated @ 2.5 amps (peak) 0.5 amps average

## PRICE: $389.00 (1K RAM) $439.00 (4K RAM)

***Plus*** $4.00 UPS (shipped in U.S. must give ***street*** address), $10 parcel post to APO's, FPO's, Alaska, Hawaii, Canada, $25 air mail to all other countries

**AIM 65 USER MANUAL $5.00 plus $1.50 shipping & handling.**

We manufacture a complete line of high quality expansion boards. Use reader service card to be added to our mailing list, or U.S. residents send $1.00 (International send $3.00 U.S.) for airmail delivery of our complete catalog.

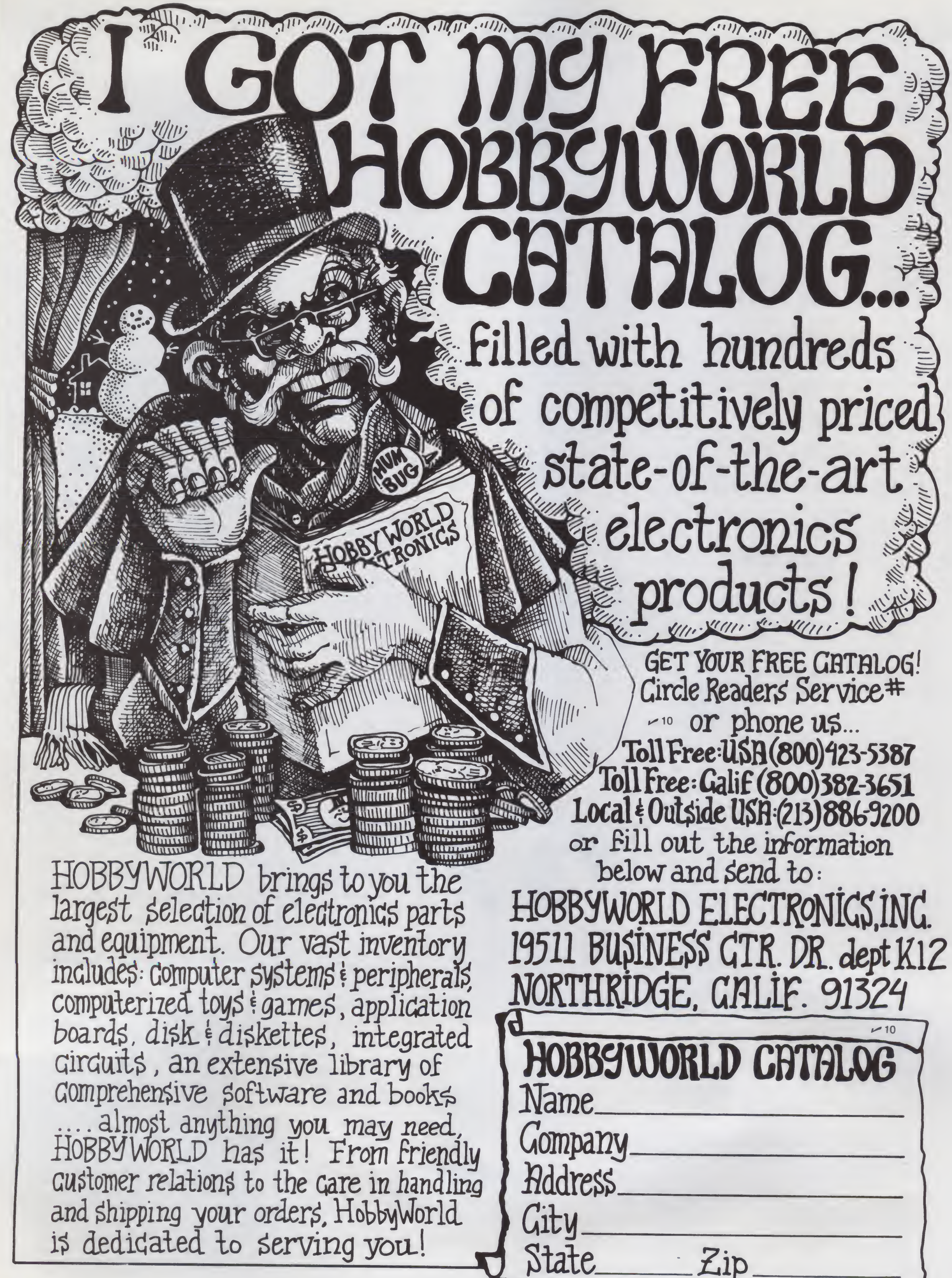
**We've Expanded Again!**
**Note our new address.**

RNB ENTERPRISES INCORPORATED

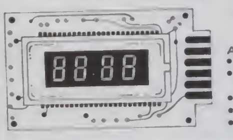
52

2951 W. Fairmount Avenue
Phoenix AZ. 85017
(602)265-7564

master charge VISA


I GOT MY FREE HOBBYWORLD CATALOG...
Filled with hundreds of competitively priced state-of-the-art electronics products!
HUM BUG
HOBBYWORLD ELECTRONICS
GET YOUR FREE CATALOG! Circle Readers Service # 10 or phone us...
Toll Free: USA (800) 423-5387
Toll Free: Calif (800) 382-3651
Local & Outside USA: (213) 886-9200
or fill out the information below and send to:
HOBBYWORLD ELECTRONICS, INC.
19511 BUSINESS CTR. DR. dept K12
NORTHRIDGE, CALIF. 91324
HOBBYWORLD brings to you the largest selection of electronics parts and equipment. Our vast inventory includes: computer systems & peripherals, computerized toys & games, application boards, disk & diskettes, integrated circuits, an extensive library of comprehensive software and books .... almost anything you may need, HOBBYWORLD has it! From friendly customer relations to the care in handling and shipping your orders, HobbyWorld is dedicated to serving you!
10
HOBBYWORLD CATALOG
Name
Company
Address
City
State
Zip

## National Semiconductor Clock Modules



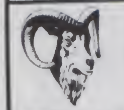
12VDC AUTOMOTIVE/ INSTRUMENT CLOCK

APPLICATIONS:
- In-dash autoclocks
- After-market auto/ RV clocks
- Aircraft-marine clks.
- 12VDC oper. instru.
- Portable/battery powered instrumnts.

Features: Bright 0.3" green display. Internal crystal time-base. ± 0.5 sec./day accur. Auto. display brightness control logic. Display color filterable to blue, blue-green, green & yellow. Complete—just add switches and lens.

**MA1003 Module ............ $16.95**

| | | |
|---|---|---|
| MA1023 | .7" Low Cost Digital LED Clock Module | 8.95 |
| MA1026 | .7" Dig. LED Alarm Clock/Thermometer | 18.95 |
| MA5036 | .3" Low Cost Digital LED Clock/Timer | 6.95 |
| MA1002 | .5" LED Display Dig. Clock & Xformer | 9.95 |



## National Semiconductor RAM SALE

**MM5290J-2** (MK4116/UPD416) . . . **$6.95 each**
16K DYNAMIC RAM (150NS)
(8 EACH $49.95) (100 EACH $550.00/lot)

**MM5298J-3A ............ $3.25 each**
8K DYNAMIC RAM (LOW HALF OF MM5290J) 200NS
(8 EACH $23.95) (100 EACH $250.00/lot)

**MM2114-3 ............ $5.95 each**
4K STATIC RAM (300NS)
(8 EACH $43.95) (100 EACH $450.00/lot)

**MM2114L-3 ............ $6.25 each**
4K STATIC RAM (LOW POWER 300NS)
(8 EACH $44.95) (100 EACH $475.00/lot)

## EPROM Erasing Lamp

- Erases 2708, 2716, 1702A, 5203Q, 5204Q, etc.
- Erases up to 4 chips within 20 minutes.
- Maintains constant exposure distance of one inch.
- Special conductive foam liner eliminates static build-up.
- Built-in safety lock to prevent UV exposure.
- Compact — only 7-5/8" x 2-7/8" x 2"
- Complete with holding tray for 4 chips.

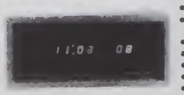
**UVS-11E ........... $79.50**

## Jumbo 6-Digit Clock Kit

- Four .630"ht. and two .300"ht. common anode displays
- Uses MM5314 clock chip
- Switches for hours, minutes and hold functions
- Hours easily viewable to 30 feet
- Simulated walnut case
- 115VAC operation
- 12 or 24 hour operation
- Includes all components, case and wall transformer
- Size: 6¾" x 3-1/8" x 1¾"

**JE747 ............ $29.95**

## 6-Digit Clock Kit



- Bright .300 ht. comm. cathode display
- Uses MM5314 clock chip
- Switches for hours, minutes and hold modes
- Hrs. easily viewable to 20 ft.
- Simulated walnut case
- 115 VAC operation
- 12 or 24 hr. operation
- Incl. all components, case & wall transformer
- Size: 6¾" x 3-1/8" x 1¾"

**JE701............ $19.95**

## Regulated Power Supply

Uses LM309K. Heat sink provided. PC board construction. Provides a solid 1 amp @ 5 volts. Can supply up to ±5V, ±9V and ±12V with JE205 Adapter. Includes components, hardware and instructions. Size: 3½" x 5" x 2"H

**JE200....... $14.95**

**ADAPTER BOARD —Adapts to JE200— ±5V, ±9V and ±12V**

DC/DC converter with +5V input. Toriodal hi-speed switching XMFR. Short circuit protection. PC board construction. Piggy-back to JE 200 board. Size: 3½" x 2" x 9/16"H

**JE205 ............ $12.95**

# MICROPROCESSOR COMPONENTS

### 8080A/8080A SUPPORT DEVICES

| | | |
|---|---|---|
| INS8080A | CPU | 6.50 |
| DP8212 | 8-Bit Input/Output | 3.25 |
| DP8214 | Priority Interrupt Control | 5.95 |
| DP8216 | Bi-Directional Bus Driver | 3.49 |
| DP8224 | Clock Generator/Driver | 3.95 |
| DP8226 | Bus Driver | 3.49 |
| DP8228 | System Controller/Bus Driver | 4.95 |
| DP8238 | System Controller | 5.95 |
| INS8243 | I/O Expander for 48 Series | 9.95 |
| INS8250 | Asynchronous Comm. Element | 16.95 |
| DP8251 | Prog. Comm. I/O (USART) | 7.95 |
| DP8253 | Prog. Interval Timer | 14.95 |
| DP8255 | Prog. Peripheral I/O (PPI) | 9.95 |
| DP8257 | Prog. DMA Control | 19.95 |
| DP8259 | Prog. Interrupt Control | 14.95 |
| DP8275 | Prog. CRT Controller | 49.95 |
| DP8279 | Prog. Keyboard/Display Interface | 19.95 |
| DP8300 | Octal Bus Receiver | 6.95 |
| DP8303 | System Timing Element | 6.95 |
| DP8304 | 8-Bit Bi-Directional Receiver | 3.95 |
| DP8307 | 8-Bit Bi-Directional Receiver | 3.95 |
| DP8308 | 8-Bit Bi-Directional Receiver | 3.95 |

### 6800/6800 SUPPORT DEVICES

| | | |
|---|---|---|
| MC6800 | MPU | 14.95 |
| MC6802CP | MPU with Clock and RAM | 19.95 |
| MC6810API | 128x8 Static RAM | 4.95 |
| MC6821 | Peripheral Inter. Adapt (MC6820) | 7.49 |
| MC6828 | Priority Interrupt Controller | 10.95 |
| MC6830L8 | 1024x8-Bit ROM (MC68A30-8) | 14.95 |
| MC6850 | Asynchronous Comm. Adapter | 6.95 |
| MC6852 | Synchronous Serial Data Adapter | 6.95 |
| MC6860 | 0-600bps Digital MODEM | 10.95 |
| MC6862 | 2400bps Modulator | 12.95 |
| MC6880A | Quad 3-State Bus. Trans. (MC8T26) | 2.25 |

### MICROPROCESSOR CHIPS

| | | |
|---|---|---|
| Z80 (780C) | CPU (MK3880N) (2MHz) | 13.95 |
| Z80A (780-1) | CPU (MK3880N-4) (4MHz) | 15.95 |
| CDP1802 | CPU | 19.95 |
| 2650 | MPU | 16.95 |
| IDM2901ADC | CPU—4-Bit Slice (Com. Temp. Grade) | 19.95 |
| MCS6502 | MPU w/Clock (65K Bytes Memory) | 11.95 |
| INS8035N-6 | MPU—8-Bit (6MHz) | 16.95 |
| INS8039N-6 | CPU—Sgl. Chip 8-Bit (128bytes RAM) | 19.95 |
| INS8040N-6 | CPU (256 Bytes RAM) | 24.95 |
| INS8070N | CPU—64 Bytes RAM | 24.95 |
| P8085 | CPU | 19.95 |
| INS8900 | CPU—16-Bit | 29.95 |
| TMS9900JL | MPU—16-Bit | 49.95 |

### SHIFT REGISTERS

| | | |
|---|---|---|
| MM500H | Dual 25-Bit Dynamic | .50 |
| MM503H | Dual 50-Bit Dynamic | .50 |
| MM506H | Dual 100-Bit Static | .50 |
| MM510H | Dual 64-Bit Accumulator | .50 |
| MM1402 | 256-Bit Dynamic | 3.95 |
| MM5013 | 1024-Bit Dynamic/Accumulator | 1.95 |
| MM5016H | 500/512-Bit Dynamic | .89 |
| MM5034N | Octal 80-Bit | 9.95 |
| MM5035N | Octal 80-Bit | 9.95 |
| 2504V (1404A) | 1024-Bit Dynamic | 3.95 |
| 2518N | Hex 32-Bit Static | 4.95 |
| 2522V | Dual 132-Bit Static | 2.95 |
| 2524V | 512-Bit Dynamic | .99 |
| 2525V | 1024-Bit Dynamic | 2.95 |
| 2527V | Dual 256-Bit Static | 2.95 |
| 2528V | Dual 250-Bit Static | 4.00 |
| 2529V | Dual 240-Bit Static | 4.00 |
| 2532N | Quad 80-Bit Static | 2.95 |
| 3341PC | Fifo (Dual 80) | 6.95 |

### DATA ACQUISITION

| | | |
|---|---|---|
| AF100-1CN | Universal Active Filter 2.5% | 5.95 |
| AF121-1CJ | Touch Tone Low Pass Filter | 19.95 |
| AF122-1CJ | Touch Tone Low Pass Filter | 19.95 |
| LM308AH | Super Gain Op Amp | 1.00 |
| LM334Z | Constant Current Source | 1.30 |
| LM335Z | Temperature Transducer | 1.40 |
| LF356N | JFET Input Op Amp | 1.10 |
| LF398N | Sample & Hold Amplifiers | 3.95 |
| LM399H | Temp. Comp. Prec. Ref. (.5ppm/C°) | 4.95 |
| ADC0804LCN | 8-Bit A/D Converter (1 LSB) | 4.95 |
| DAC0806LCN | 8-Bit D/A Converter (0.78% Lin.) | 2.25 |

### DATA ACQUISITION (CONTINUED)

| | | |
|---|---|---|
| ADC0809CCN | 8-Bit A/D Converter (8-Ch. Multi.) | 5.25 |
| ADC0817CCN | 8-Bit A/D Converter (16-Ch. Multi.) | 10.95 |
| DAC1000LCN | 10-Bit D/A Conv. Micro. Comp. (0.05%) | 13.95 |
| DAC1008LCN | 10-Bit D/A Conv. Micro. Comp. (0.20%) | 8.95 |
| DAC1020LCN | 10-Bit D/A Converter (0.05% Lin.) | 8.49 |
| DAC1022LCN | 10-Bit D/A Converter (0.20% Lin.) | 5.95 |
| DAC1222LCN | 12-Bit D/A Converter (0.20% Lin.) | 9.95 |
| CD4051N | 8-Channel Multiplexer | 1.19 |
| AY-5-1013 | 30K BAUD UART | 5.95 |

### RAM'S

| | | |
|---|---|---|
| 1101 | 256x1 Static | 1.49 |
| 1103 | 1024x1 Dynamic | .99 |
| 2101 (8101) | 256x4 Static | 3.95 |
| 2102 | 1024x1 Static | 1.75 |
| 21L02 | 1024x1 Static | 1.95 |
| 2111 (8111) | 256x4 Static | 3.95 |
| 2112 | 256x4 Static MOS | 4.95 |
| 2114 | 1024x4 Static 450ns | 5.95 |
| 2114L | 1024x4 Static 450ns Low Power | 6.95 |
| 2114-3 | 1024x4 Static 300ns | 7.49 |
| 2114L-3 | 1024x4 Static 300ns Low Power | 7.95 |
| 2117 | 16,384x1 Dynamic 560ns (housemarked) | 4.95 |
| MM2147J | 4096x1 Fast 70ns | 19.95 |
| 5101 | 256x4 Static | 7.95 |
| MM5261 | 1024x1 Dynamic Fully Decoded | .99 |
| MM5262 | 2Kx1 Dynamic | .25 |
| MM5280/2107 | 4096x1 Dynamic | 4.95 |
| MM5290J-2(4116) | 16K Dynamic 250ns (UPD416) | 6.95 |
| MM5298J-3A | 8K Dyn. 200ns (lower ½ of MM5290J) | 4.95 |
| 7489 | 16x4 Static | 1.75 |
| UPD414/MK4027 | 4K Dynamic 16-pin | 4.95 |
| TMS4044-45NL | 4K Static | 14.95 |
| TMS4045 | 1024x4 Static | 14.95 |

### PROMS/EPROMS

| | | |
|---|---|---|
| 1702A | 2K UV Erasable PROM | 5.95 |
| 2708 | 8K EPROM | 9.95 |
| TMS2716 | 16K EPROM (-5V, +5V, +12V) | 19.95 |
| 2716Intel(2516)TI | 16K EPROM (Single +5V) | 17.95 |
| 2732Intel(2532)TI | 32K EPROM | 49.95 |
| 2758 | 8K EPROM (450ns) (Single +5V) | 7.95 |
| 5203 | 2048 PROM | 14.95 |
| 82S23(74S188) | 32x8 PROM (Open Collector) | 4.95 |
| 82S115 | 4096 Bipolar PROM | 19.95 |
| 82S123(74S288) | 32x8 Tri-State Bipolar PROM | 4.95 |
| 82S185 | 8K PROM | 29.95 |

### ROM'S

| | | |
|---|---|---|
| 2513(2140) | Character Generator (Upper Case) | 9.95 |
| 2513(3021) | Character Generator (Lower Case) | 9.95 |
| 2516N | Character Generator | 10.95 |
| MM5230N | 2048-Bit Read Only Memory | 1.95 |

### NMOS READ ONLY MEMORIES

| | | |
|---|---|---|
| MCM66710P | 128x9x7 ASCII Shifted w/Greek | 13.50 |
| MCM66740P | 128x9x7 Math Symbol & Pictures | 13.50 |
| MCM66750P | 128x9x7 Alpha. Control Char. Gen. | 13.50 |

### MICROPROCESSOR MANUALS

| | | |
|---|---|---|
| M-Z80 | User Manual | 7.50 |
| M-CDP1802 | User Manual | 7.50 |
| M-2650 | User Manual | 5.00 |

### SPECIAL FUNCTION

| | | |
|---|---|---|
| DS0025CN | Dual MOS Clock Driver (5MZ) | 3.50 |
| DS0026CN | Dual MOS Clock Driver (5MZ) | 1.95 |
| INS1771N-1 | Floppy Disc Controller | 24.95 |
| INS2651N | Communication Chip | 19.95 |
| MM58167N | Microprocessor Real Time Clock | 8.95 |
| MM58174N | Microprocessor Compatible Clock | 11.95 |
| COP402N | Microcontroller with 64-Digit RAM and Direct LED Drive | 6.95 |
| COP402MN | Microcontroller with 64-Digit RAM & Direct LED Drive w/N Buss Int. | 7.49 |
| COP470N | 32-Seg. VAC Fluor. Driver (20-pin pkg.) | 3.25 |

### TELEPHONE/KEYBOARD CHIPS

| | | |
|---|---|---|
| AY-5-9100 | Push Button Telephone Dialer | 14.95 |
| AY-5-9200 | Repertory Dialer | 14.95 |
| AY-5-9500 | CMOS Clock Generator | 4.95 |
| AY-5-2376 | Keyboard Encoder (88 keys) | 11.95 |
| HD0165-5 | Keyboard Encoder (16 keys) | 7.95 |
| 74C922 | Keyboard Encoder (16 keys) | 5.49 |
| 74C923 | Keyboard Encoder (20 keys) | 5.75 |
| MM53190N | Push Button Pulse Dialer | 7.95 |
| MM57499N | 96/144-Key Serial Keyboard Encoder | 8.95 |

## DESIGNERS' SERIES
## Blank Desk-Top Electronic Enclosures

- High strength epoxy molded end pieces in mocha brown finish.
- Sliding rear/bottom panel for service and component accessibility.
- Top / bottom panels .080 thk alum. Alodine type 1200 finish (gold tint color) for best paint adhesion after modification.
- Vented top and bottom panels for cooling efficiency.
- Rigid construction provides unlimited applications.

**CONSTRUCTION:**
**The "DTE" Blank Desk Top Electronic Enclosures** are designed to blend and complement today's modern computer equipment and can be used in both industrial and home. The end pieces are precision molded with an internal slot (all around) to accept both top and bottom panels. The panels are then fastened to ¼" thick tabs inside the end pieces to provide maximum rigidity to the enclosure. For ease of equipment servicing, the rear/bottom panel slides back on slotted tracks while the rest of the enclosure remains intact. Different panel widths may be used while maintaining a common profile outline. The molded end pieces can also be painted to match any panel color scheme.

| Enclosure Model No. | Panel Width | PRICE |
|---|---|---|
| DTE-8 | 8.00" | $29.95 |
| DTE-11 | 10.65" | $32.95 |
| DTE-14 | 14.00" | $34.95 |

$10.00 Min. Order — U.S. Funds Only
Calif. Residents Add 6% Sales Tax
Postage — Add 5% plus $1 Insurance

Spec Sheets — 25¢
1981 Catalog Available — Send 41¢ stamp

NEW 1981 CATALOG

**Jameco ELECTRONICS**

PHONE ORDERS WELCOME (415) 592-8097

*MAIL ORDER ELECTRONICS – WORLDWIDE*
1355 SHOREWAY ROAD, BELMONT, CA 94002
PRICES SUBJECT TO CHANGE

12/80

## COMPUTER CUBE™



**COMPUTER CRT MONITOR & ACCESSORY CASE**
- One piece heavy duty molded construction
- Painted to match Apple II & III (Lt. beige, textured finish)
- Smoke colored acrylic front cover (removable)
- Built-in shelf holds CRT and allows room for 2 Apple
- disk drives below shelf
- Three 2½" holes provided in bottom of case for addition
- of fan if needed.
- Fan hole positioned above Apple motherboard location.
- Hookup cables can be run through other 2 holes.
- Case accommodates most B&W and Color uncased CRT
- monitors made by Motorola, Bell Bros., Zenith, Sanyo,
- Panasonic, Hitachi, etc. or any monitor that will fit into
- 10-3/8"H x 14½"W x 13¾"D space.
- Size: 15" x 15" x 15" O.D., 14½"H x 14½"W x 13¾" I.D.
- Weight: approximately 12 lbs.
- CRT monitor fan and disk drives not included.

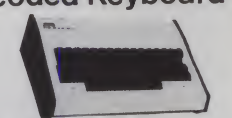
**CUBE-1 ........... $99.95**

## TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K.
Kit comes complete with:
- 8 each MM5290-2 (UPD416) (16K Dynamic Rams) (250NS or less)
- Documentation for conversion

**TRS-16K ........... $49.95**

## JE610 ASCII Encoded Keyboard Kit



The JE610 ASCII Keyboard Kit can be interfaced into most any computer system. The kit comes complete with an industrial grade keyboard switch assembly (62-keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and −12V @ 10 mA for operation. Features: 60 keys generate the 126 characters, upper and lower case ASCII set. Fully buffered. Two user-define keys provided for custom applications. Caps lock for upper-case-only alpha characters. Utilizes a 2376 (40-pin) encoder read-only memory chip. Outputs directly compatible with TTL/DTL or MOS logic arrays. Easy interfacing with a 16-pin dip or 18-pin edge connector.

**JE610** (Case not included) **$79.95**
K62 (Keyboard only) ......... $34.95

### Desk-Top Enclosure for JE610 ASCII Encoded Keyboard Kit

Compact desk-top enclosure: Color-coordinated designer's case with light tan aluminum panels and molded end pieces in mocha brown. Includes mounting hardware. Size: 3½"H x 14½"W x 8¾"D.

DTE-AK ................... $49.95

*SPECIAL:* JE610/DTE-AK PURCHASED TOGETHER (Value $129.90) ............... $124.95

## JE600 Hexadecimal Encoder Kit

**FULL 8-BIT LATCHED OUTPUT 19-KEY KEYBOARD**

The JE600 Encoder Keyboard Kit provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8-bit microprocessor or 8-bit memory circuits. Three additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with 9 LED readouts. Also included is a key entry strobe. Features: Full 8-bit latched output for microprocessor use. Three user-define keys with one being bistable operation. Debounce circuit provided for all 19 keys. 9 LED readouts to verify entries. Easy interfacing with standard 16-pin IC connector. Only +5VDC required for operation.

**JE600** (Case not included) **$59.95**
K19 (Keyboard only) ......... $14.95

### Desk-Top Enclosure for JE600 Hexadecimal Keyboard Kit

Compact desk-top exclosure: Color-coordinated designer's case with light tan aluminum panels and molded end pieces in mocha brown. Includes mounting hardware. Size: 3½"H x 8¾"W x 8¾"D.

DTE-HK ................... $44.95

*SPECIAL:* JE600/DTE-HK PURCHASED TOGETHER (Value $104.90) ............. $99.95

## 7400

| | | | | | |
|---|---|---|---|---|---|
| SN7400N | .25 | SN7472N | .29 | SN74156N | .79 |
| SN7401N | .20 | SN7473N | .35 | SN74157N | .69 |
| SN7402N | .25 | SN7474N | .35 | SN74160N | .89 |
| SN7403N | .25 | SN7475N | .49 | SN74161N | .89 |
| SN7404N | .25 | SN7476N | .35 | SN74162N | .89 |
| SN7405N | .29 | SN7480N | .50 | SN74163N | .89 |
| SN7406N | .29 | SN7482N | .99 | SN74164N | .89 |
| SN7407N | .35 | SN7483N | .69 | SN74165N | .89 |
| SN7408N | .29 | SN7485N | .89 | SN74166N | 1.25 |
| SN7409N | .29 | SN7486N | .35 | SN74167N | 2.79 |
| SN7410N | .25 | SN7489N | 1.75 | SN74170N | 1.95 |
| SN7411N | .29 | SN7490N | .49 | SN74172N | 4.95 |
| SN7412N | .35 | SN7491N | .59 | SN74173N | 1.39 |
| SN7413N | .40 | SN7492N | .45 | SN74174N | .99 |
| SN7414N | .69 | SN7493N | .45 | SN74175N | .89 |
| SN7416N | .29 | SN7494N | .69 | SN74176N | .79 |
| SN7417N | .29 | SN7495N | .69 | SN74177N | .79 |
| SN7420N | .25 | SN7496N | .69 | SN74179N | 1.49 |
| SN7421N | .25 | SN7497N | 3.00 | SN74180N | .79 |
| SN7422N | .45 | SN74100N | 1.49 | SN74181N | 2.25 |
| SN7423N | .29 | SN74107N | .35 | SN74182N | .79 |
| SN7425N | .29 | SN74109N | .39 | SN74184N | 2.49 |
| SN7426N | .29 | SN74116N | 1.95 | SN74185N | 2.49 |
| SN7427N | .25 | SN74121N | .39 | SN74190N | 1.25 |
| SN7429N | .39 | SN74122N | .55 | SN74191N | 1.25 |
| SN7430N | .25 | SN74123N | .59 | SN74192N | .89 |
| SN7432N | .25 | SN74125N | .49 | SN74193N | .89 |
| SN7437N | .25 | SN74126N | .49 | SN74194N | .89 |
| SN7438N | .40 | SN74132N | .75 | SN74195N | .69 |
| SN7429N | .25 | SN74136N | .75 | SN74196N | .89 |
| SN7440N | .20 | SN74141N | .99 | SN74197N | .89 |
| SN7441N | .89 | SN74142N | 3.25 | SN74198N | 1.49 |
| SN7442N | .25 | SN74143N | 3.49 | SN74199N | 1.49 |
| SN7443N | 1.10 | SN74144N | 3.49 | SN74221N | 1.49 |
| SN7444N | 1.10 | SN74145N | .79 | SN74251N | .99 |
| SN7445N | .89 | SN74147N | 1.95 | SN74276N | 1.95 |
| SN7446N | .79 | SN74148N | 1.29 | SN74279N | .79 |
| SN7447N | .69 | SN74150N | 1.25 | SN74283N | 1.49 |
| SN7448N | .79 | SN74151N | .69 | SN74284N | 3.95 |
| SN7450N | .20 | SN74152N | .69 | SN74285N | 3.95 |
| SN7451N | .20 | SN74153N | .79 | SN74365N | .69 |
| SN7453N | .20 | SN74154N | 1.25 | SN74366N | .69 |
| SN7454N | .20 | SN74155N | .79 | SN74367N | .69 |
| SN7459A | .25 | | | SN74368N | .69 |
| SN7460N | .20 | | | SN74390N | 1.49 |
| SN7470N | .29 | | | SN74393N | 1.49 |

## 74LS

| | | | | | |
|---|---|---|---|---|---|
| 74LS00 | .29 | 74LS92 | .75 | 74LS192 | 1.15 |
| 74LS01 | .29 | 74LS93 | .75 | 74LS193 | 1.15 |
| 74LS02 | .29 | 74LS95 | .99 | 74LS194 | 1.15 |
| 74LS03 | .29 | 74LS96 | 1.15 | 74LS195 | 1.15 |
| 74LS04 | .35 | 74LS107 | .45 | 74LS197 | 1.19 |
| 74LS05 | .35 | 74LS109 | .45 | 74LS221 | 1.19 |
| 74LS08 | .29 | 74LS112 | .45 | 74LS240 | 1.95 |
| 74LS09 | .35 | 74LS113 | .49 | 74LS241 | 1.95 |
| 74LS10 | .29 | 74LS114 | .49 | 74LS242 | 1.95 |
| 74LS11 | .75 | 74LS122 | .89 | 74LS243 | 1.95 |
| 74LS12 | .35 | 74LS123 | 1.25 | 74LS244 | 1.95 |
| 74LS13 | .59 | 74LS125 | .89 | 74LS245 | 2.95 |
| 74LS14 | .99 | 74LS126 | .55 | 74LS247 | 1.19 |
| 74LS15 | .29 | 74LS132 | .99 | 74LS248 | 1.19 |
| 74LS20 | .29 | 74LS133 | .89 | 74LS249 | 1.19 |
| 74LS21 | .35 | 74LS136 | .49 | 74LS251 | 1.49 |
| 74LS22 | .35 | 74LS138 | .89 | 74LS253 | .99 |
| 74LS26 | .35 | 74LS139 | .89 | 74LS257 | .89 |
| 74LS27 | .35 | 74LS151 | .89 | 74LS258 | .99 |
| 74LS28 | .35 | 74LS153 | .89 | 74LS260 | .69 |
| 74LS30 | .29 | 74LS154 | 1.75 | 74LS266 | .69 |
| 74LS32 | .35 | 74LS155 | 1.19 | 74LS273 | 1.95 |
| 74LS33 | .59 | 74LS156 | 1.19 | 74LS279 | .75 |
| 74LS37 | .45 | 74LS157 | .89 | 74LS283 | 1.09 |
| 74LS38 | .49 | 74LS158 | .99 | 74LS290 | .99 |
| 74LS40 | .35 | 74LS160 | 1.15 | 74LS293 | .99 |
| 74LS42 | .89 | 74LS161 | 1.15 | 74LS298 | 1.25 |
| 74LS47 | .89 | 74LS162 | 1.15 | 74LS352 | 1.29 |
| 74LS48 | 1.15 | 74LS163 | 1.15 | 74LS353 | 1.29 |
| 74LS49 | 1.15 | 74LS164 | 1.25 | 74LS365 | .75 |
| 74LS51 | .29 | 74LS165 | 1.25 | 74LS366 | .75 |
| 74LS54 | .29 | 74LS168 | 1.19 | 74LS367 | .75 |
| 74LS55 | .29 | 74LS169 | 1.19 | 74LS368 | .75 |
| 74LS73 | .45 | 74LS170 | 2.49 | 74LS373 | 1.95 |
| 74LS74 | .45 | 74LS173 | 1.39 | 74LS374 | 1.95 |
| 74LS75 | .59 | 74LS174 | .99 | 74LS375 | .89 |
| 74LS76 | .45 | 74LS175 | .99 | 74LS386 | .69 |
| 74LS78 | .49 | 74LS181 | 2.95 | 74LS393 | 2.49 |
| 74LS83 | .89 | 74LS190 | 1.25 | 74LS399 | 2.49 |
| 74LS85 | 1.25 | 74LS191 | 1.25 | 74LS670 | 2.49 |
| 74LS86 | .45 | | | 81LS95 | 1.95 |
| 74LS90 | .59 | | | 81LS97 | 1.95 |

## 74S

| | | | | | |
|---|---|---|---|---|---|
| 74S00 | .50 | 74S133 | .55 | 74S244 | 3.25 |
| 74S02 | .50 | 74S134 | .69 | 74S251 | 1.45 |
| 74S03 | .50 | 74S135 | 1.19 | 74S253 | 1.45 |
| 74S04 | .55 | 74S136 | 1.75 | 74S257 | 1.35 |
| 74S05 | .55 | 74S138 | 1.35 | 74S258 | 1.35 |
| 74S08 | .50 | 74S139 | 1.35 | 74S260 | .79 |
| 74S09 | .50 | 74S140 | 1.15 | 74S280 | 2.95 |
| 74S10 | .50 | 74S151 | 1.35 | 74S287* | 4.95 |
| 74S11 | .50 | 74S153 | 1.35 | 74S288* | 4.95 |
| 74S15 | .50 | 74S157 | 1.35 | 74S373 | 3.49 |
| 74S20 | .50 | 74S158 | 1.35 | 74S374 | 3.49 |
| 74S22 | .50 | 74S174 | 1.59 | 74S387* | 5.95 |
| 74S30 | .50 | 74S175 | 1.59 | 74S471* | 19.95 |
| 74S32 | .55 | 74S188 | 4.95 | 74S472* | 19.95 |
| 74S40 | .55 | 74S194 | 1.95 | 74S473* | 19.95 |
| 74S51 | .50 | 74S195 | 1.95 | 74S474* | 21.95 |
| 74S64 | .50 | 74S196 | 3.95 | 74S475* | 21.95 |
| 74S65 | .50 | 74S240 | 2.95 | 74S570* | 7.95 |
| 74S74 | .79 | 74S241 | 2.95 | 74S571* | 7.95 |
| 74S86 | .79 | 74S242 | 3.25 | 74S572* | 19.95 |
| 74S112 | .79 | 74S243 | 3.25 | 74S573* | 19.95 |
| 74S113 | .79 | | | 74S940 | 3.15 |
| 74S114 | .79 | | | 74S941 | 3.15 |

* LIMITED AVAILABILITY ON THESE PROMS

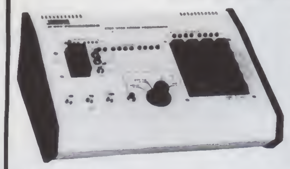
## CA–LINEAR

| | | | | | |
|---|---|---|---|---|---|
| CA3013H | 2.15 | CA3081N | 2.00 | CA3089N | 3.75 |
| CA3023H | 3.25 | CA3082N | 2.00 | CA3096N | 3.95 |
| CA3039H | 1.35 | CA3083N | 1.60 | CA3130H | 1.39 |
| CA3046N | 1.30 | CA3086N | .85 | CA3140H | 1.25 |
| CA3059N | 3.25 | | | CA3160H | 1.25 |
| CA3060N | 3.25 | | | CA3401N | .59 |
| CA3080H | 1.25 | | | CA3600N | 3.50 |

## CD–CMOS

| | | | | | |
|---|---|---|---|---|---|
| CD4000 | .39 | CD4041 | 1.49 | CD4082 | .39 |
| CD4001 | .39 | CD4042 | .99 | CD4093 | .99 |
| CD4002 | .39 | CD4043 | .89 | CD4098 | 2.49 |
| CD4006 | 1.19 | CD4044 | .89 | CD4506 | .75 |
| CD4007 | .25 | CD4046 | 1.79 | CD4507 | .99 |
| CD4009 | .49 | CD4047 | 2.50 | CD4508 | 3.95 |
| CD4010 | .49 | CD4048 | 1.35 | CD4510 | 1.39 |
| CD4011 | .39 | CD4049 | .49 | CD4511 | 1.29 |
| CD4012 | .25 | CD4050 | .69 | CD4514 | 3.95 |
| CD4013 | .49 | CD4051 | 1.19 | CD4515 | 2.95 |
| CD4014 | 1.39 | CD4052 | 1.19 | CD4516 | 1.49 |
| CD4015 | 1.19 | CD4053 | 1.19 | CD4518 | 1.79 |
| CD4016 | .59 | CD4056 | 2.95 | CD4519 | .89 |
| CD4017 | 1.19 | CD4059 | 9.95 | CD4520 | 1.29 |
| CD4018 | .99 | CD4060 | 1.49 | CD4526 | 1.79 |
| CD4019 | .49 | CD4066 | .79 | CD4528 | 1.79 |
| CD4020 | 1.19 | CD4068 | .39 | CD4529 | 1.95 |
| CD4021 | 1.39 | CD4069 | .45 | CD4543 | 2.79 |
| CD4022 | 1.19 | CD4070 | .55 | CD4562 | 11.95 |
| CD4023 | .29 | CD4071 | .49 | CD4566 | 2.79 |
| CD4024 | .79 | CD4072 | .49 | CD4583 | 2.49 |
| CD4025 | .23 | CD4073 | .39 | CD4723 | 1.95 |
| CD4026 | 2.95 | CD4075 | .39 | CD4724 | 1.95 |
| CD4027 | .69 | CD4076 | 1.39 | MC14409 | 14.95 |
| CD4028 | .89 | CD4081 | .39 | MC14410 | 14.95 |
| CD4029 | 1.49 | | | MC14411 | 14.95 |
| CD4030 | .49 | | | MC14412 | 11.95 |
| CD4035 | .99 | | | MC14419 | 4.95 |
| CD4040 | 1.49 | | | MC14433 | 13.95 |

## JE608 PROGRAMMER
### 2708 EPROM PROGRAMMER



- 3 separate Display Registers: 8 LED's for Hex Key entries, 10 LED's (2°-2°) for Address Register and 8 LED's for Data Memory Register. The Data Memory Register displays the content of the RAMs from the EPROM Chip.
- Development of microprocessor systems by means of a ribbon cable from the programmer panel test socket to the EPROM socket on the microprocessor board.
- Rapid checking verification of programmed data changes.
- User may move data from a master to RAM's or write into RAM's with keyboard entries.
- Allows manual stepping manipulation (up and down) at any address location.
- Stand alone EPROM Programmer consisting of: A 18-key Hexadecimal Keyboard assembly, Programmer Board assembly with 4 power supplies and a LED/Test Socket Panel Board assembly. The Test Socket is zero force insertion type. Power requirements: 115VAC, 60Hz, 6W
- Compact desk top enclosure: Color-coordinated designer's case with light tan panels and molded end pieces in mocha brown. Size: 3¼"H x 11"W x 8¼"D. Weight: 5 lbs.

The JE608 EPROM Programmer is a completely self contained unit which is independent of computer control and requires no additional systems for its operations. The EPROM can be programmed from the Hexadecimal Keyboard or from a pre-programmed EPROM. The JE608 Programmer can emulate a programmed EPROM by the use of its internal RAM circuits. This will allow the user to test or pretest a program, for a system, prior to programming a chip. Any changes in the program can be entered directly into the memory circuits with the Hexadecimal Keyboard so that rewriting the entire program will not be necessary. The JE608 Programmer contains a Programmer/Board with 25 IC's and including power supplies of: 5V, +5V, +12V and +26V. The Hexadecimal Keyboard and LED/Test Socket Panel Board are separate assemblies within the system.

**JE608K KIT** .......... **$399.95**
**JE608A Assembled and tested** .......... **$499.95**

## DISCRETE LEDS

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| XC556R | .200" | red | 5/$1 | MV50 | .085" | red | 6/$1 | XC111R | .190" | red | 5/$1 |
| XC556G | .200" | green | 4/$1 | XC209R | .125" | red | 5/$1 | XC111G | .190" | green | 4/$1 |
| XC556Y | .200" | yellow | 4/$1 | XC209G | .125" | green | 4/$1 | XC111Y | .190" | yellow | 4/$1 |
| XC556C | .200" | clear | 4/$1 | XC209Y | .125" | yellow | 4/$1 | XC111C | .190" | clear | 4/$1 |
| XC22R | .200" | red | 5/$1 | XC526R | .185" | red | 5/$1 | | | | |
| XC22G | .200" | green | 4/$1 | XC526G | .185" | green | 4/$1 | | | | |
| XC22Y | .200" | yellow | 4/$1 | XC526Y | .185" | yellow | 4/$1 | | | | |
| MV10B | .170" | red | 4/$1 | XC526C | .185" | clear | 4/$1 | | | | |

INFRA-RED LED
¼"x ¼"x 1/16" flat
IRL — 5/$1

## DISPLAY LEDS

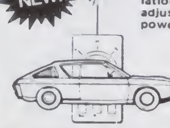
C.A. — Common Anode C.C. — Common Cathode

| Type | Polarity | Ht | Price | Type | Polarity | Ht | Price |
|---|---|---|---|---|---|---|---|
| MAN 1 | C.A.—red | .270 | 2.95 | DL741 | C.A.—red | .600 | 1.25 |
| MAN 2 | 5x7 D.M.—red | .300 | 4.95 | DL746 | C.A.—red ± 1 | .630 | 1.49 |
| MAN 3 | C.C.—red | .125 | .25 | DL747 | C.A.—red | .600 | 1.49 |
| MAN 52 | C.A.—green | .300 | 1.25 | DL750 | C.C.—red | .600 | 1.49 |
| MAN 54 | C.C.—green | .300 | 1.25 | DL33B | C.C.—red | .110 | .35 |
| MAN 71 | C.A.—red | .300 | .75 | FND70 | C.C. | .250 | .69 |
| MAN 72 | C.A.—red | .300 | .75 | FND358 | C.C. ± 1 | .357 | .99 |
| MAN 74 | C.C.—red | .300 | 1.25 | FND359 | C.C. | .357 | .75 |
| MAN 82 | C.A.—yellow | .300 | .49 | FND503 | C.C. (FND500) | .500 | .99 |
| MAN 84 | C.C.—yellow | .300 | .99 | FND507 | C.A. (FND510) | .500 | .99 |
| MAN 3620 | C.A.—orange | .300 | .49 | HDSP-3401 | C.A.—red | .800 | 1.50 |
| MAN 3630 | C.A.—orange ± 1 | .300 | .99 | HDSP-3403 | C.C.—red | .800 | 1.50 |
| MAN 3640 | C.C.—orange | .300 | .99 | 5082-7613 | C.C.,R.H.D.—red | .300 | 1.25 |
| MAN 4610 | C.A.—orange | .400 | .99 | 5082-7620 | C.A.,L.H.D.—yel. | .300 | 1.25 |
| MAN 6610 | C.A.—orange—DD | .560 | .99 | 5082-7623 | C.C.,R.H.D.—yel. | .300 | 1.25 |
| MAN 6630 | C.A.—orange ± 1 | .560 | .99 | 5082-7730 | C.A.,L.H.D.—red | .300 | .99 |
| MAN 6640 | C.C.—orange—DD | .560 | .99 | 5082-7731 | C.A.,R.H.D.—red | .300 | 1.25 |
| MAN 6650 | C.C.—orange ± 1 | .560 | .99 | 5082-7750 | C.A.,L.H.D.—red | .430 | 1.75 |
| MAN 6660 | C.A.—orange | .560 | .99 | 5082-7751 | C.A.,R.H.D.—red | .430 | 1.25 |
| MAN 6710 | C.A.—red—DD | .560 | .99 | 5082-7760 | C.C.,R.H.D.—red | .430 | 1.75 |
| MAN 6750 | C.C.—red ± 1 | .560 | .99 | 5082-7300 | 4x7 sgl. dig. RHD | .600 | 22.00 |
| MAN 6780 | C.C.—red | .560 | .99 | 5082-7302 | 4x7 sgl. dig. LHD | .600 | 22.00 |
| DL704 | C.C.—red | .300 | 1.25 | 5082-7304 | Overnge. char. (±1) | .600 | 19.95 |
| DL707 | C.A.—red | .300 | 1.25 | LIT-1 | Photo Xsistor Opto-Isol. | | .69 |
| DL728 | C.C.—red | .500 | 1.49 | MOC3010 | Optically Isol. Triac Driver | | 1.25 |

## RADIO CONTROL CIRCUITS

NEW!

Ideal for remote control systems which use pulse amplitude modulation (toy cars, boats, tanks, etc.) Features: five function control, adjustable steering angle, suitable for 27 and 47MHz bands and low power consumption.



**KB-4428 TRANSMITTER** .......... **$4.25**
Abs. max. rating (TA@25° C). Supply volt.: Vcc1 12VDC. Power Dissip.: PD: 300mW; Temp. range: Oper. 0-+50°C — Storage -30— +125° C. Rec. oper. volt.: 7-11V. Crystal or CR Oscillation circuits acceptable.

**KB-4429 RECEIVER** .......... **$5.95**
Abs. max. rating (TA@25°C). Supply volt.: Vcc1: 11V. Vcc2: 7.5V. Power Dissip.: 600mW. Temp. range: Oper. 0 ± 50°C. Rec. oper. volt.: VOP1 7-11V — VOP2 3-6V.

## LOW PROFILE (TIN) SOCKETS

| | 1-24 | 25-49 | 50-100 |
|---|---|---|---|
| 8 pin LP | .17 | .16 | .15 |
| 14 pin LP | .20 | .19 | .18 |
| 16 pin LP | .22 | .21 | .20 |
| 18 pin LP | .29 | .28 | .27 |
| 20 pin LP | .34 | .32 | .30 |
| 22 pin LP | .37 | .36 | .35 |
| 24 pin LP | .38 | .37 | .36 |
| 28 pin LP | .45 | .44 | .43 |
| 36 pin LP | .60 | .59 | .58 |
| 40 pin LP | .63 | .62 | .61 |

## SOLDERTAIL STANDARD (TIN)

| | 1-24 | 25-49 | 50-100 |
|---|---|---|---|
| 14 pin ST | .27 | .25 | .24 |
| 16 pin ST | .30 | .27 | .25 |
| 18 pin ST | .35 | .32 | .30 |
| 24 pin ST | .49 | .45 | .42 |
| 28 pin ST | .99 | .90 | .81 |
| 36 pin ST | 1.39 | 1.26 | 1.15 |
| 40 pin ST | 1.59 | 1.45 | 1.30 |

## SOLDERTAIL (GOLD) STANDARD

| | 1-24 | 25-49 | 50-100 |
|---|---|---|---|
| 8 pin SG | .39 | .35 | .31 |
| 14 pin SG | .49 | .45 | .41 |
| 16 pin SG | .54 | .49 | .44 |
| 18 pin SG | .59 | .53 | .48 |
| 24 pin SG | .79 | .75 | .69 |
| 28 pin SG | 1.10 | 1.00 | .90 |
| 36 pin SG | 1.65 | 1.40 | 1.26 |
| 40 pin SG | 1.75 | 1.59 | 1.45 |

## WIRE WRAP SOCKETS (GOLD) LEVEL #3

| | 1-24 | 25-49 | 50-100 |
|---|---|---|---|
| 8 pin WW | .59 | .54 | .49 |
| 10 pin WW | .69 | .63 | .58 |
| 14 pin WW | .79 | .73 | .67 |
| 16 pin WW | .85 | .77 | .70 |
| 18 pin WW | .99 | .90 | .81 |
| 20 pin WW | 1.19 | 1.08 | .99 |
| 22 pin WW | 1.49 | 1.35 | 1.23 |
| 24 pin WW | 1.39 | 1.26 | 1.14 |
| 28 pin WW | 1.69 | 1.53 | 1.38 |
| 36 pin WW | 2.19 | 1.99 | 1.79 |
| 40 pin WW | 2.29 | 2.09 | 1.89 |

## 1/4 WATT RESISTOR ASSORTMENTS – 5%

| | | | | |
|---|---|---|---|---|
| ASST. 1 | 5ea. | 10 Ohm 12 Ohm 15 Ohm 18 Ohm 22 Ohm 27 Ohm 33 Ohm 39 Ohm 47 Ohm 56 Ohm | 50pcs. | $1.95 |
| ASST. 2 | 5ea. | 68 Ohm 82 Ohm 100 Ohm 120 Ohm 150 Ohm 180 Ohm 220 Ohm 270 Ohm 330 Ohm 390 Ohm | 50pcs. | $1.95 |
| ASST. 3 | 5ea. | 470 Ohm 560 Ohm 680 Ohm 820 Ohm 1K 1.2K 1.5K 1.8K 2.2K 2.7K | 50pcs. | $1.95 |
| ASST. 4 | 5ea. | 3.3K 3.9K 4.7K 5.6K 6.8K 8.2K 10K 12K 15K 18K | 50pcs. | $1.95 |
| ASST. 5 | 5ea. | 22K 27K 33K 39K 47K 56K 68K 82K 100K 120K | 50pcs. | $1.95 |
| ASST. 6 | 5ea. | 150K 180K 220K 270K 330K 390K 470K 560K 680K 820K | 50pcs. | $1.95 |
| ASST. 7 | 5ea. | 1M 1.2M 1.5M 1.8M 2.2M 2.7M 3.3M 3.9M 4.7M 5.6M | 50pcs. | $1.95 |
| ASST. 8R | | Includes Resistor Assts. 1-7 (350 pcs.) | | $10.95 ea. |

$10.00 Min. Order — U.S. Funds Only
Calif. Residents Add 6% Sales Tax
Postage — Add 5% plus $1 Insurance

Spec Sheets — 25¢
1981 Catalog Available — Send 41¢ stamp

NEW 1981 CATALOG

**Jameco ELECTRONICS**

PHONE ORDERS WELCOME (415) 592-8097

*MAIL ORDER ELECTRONICS – WORLDWIDE*
1355 SHOREWAY ROAD, BELMONT, CA 94002
12/80 PRICES SUBJECT TO CHANGE

## INTERSIL

| Part No. | Function | Price |
|---|---|---|
| 7045IPI | CMOS Precision Timer | 14.95 |
| 7045EV/Kit* | Stopwatch Chip, XTL | 22.95 |
| 7106CPL | 3½ Digit A/D (LCD Drive) | 16.95 |
| 7106EV/Kit* | IC, Circuit Board, Display | 34.95 |
| 7107CPL | 3½ Digit A/D (LED Drive) | 15.95 |
| 7107EV/Kit* | IC, Circuit Board, Display | 28.95 |
| 7116CPL | 3½ Digit A/D LCD Dis. HLD. | 18.95 |
| 7117CPL | 3½ Digit A/D LED Dis. HLD. | 17.95 |
| 7201IDR | Low Battery Volt Indicator | 2.25 |
| 7205IPG | CMOS LED Stopwatch/Timer | 12.95 |
| 7205EV/Kit* | Stopwatch Chip, XTL | 19.95 |
| 7206CJPE | Tone Generator | 5.15 |
| 7206CEV/Kit* | Tone Generator Chip, XTL | 9.95 |
| 7207AIPD | Oscillator Controller | 6.50 |
| 7207AEV/Kit* | Freq. Counter Chip, XTL | 11.10 |
| 7208IPI | Seven Decade Counter | 17.95 |
| 7209IPA | Clock Generator | 3.95 |
| 7215IPG | 4 Func. CMOS Stopwatch CKT | 13.95 |
| 7215EV/Kit* | 4 Func. Stopwatch Chip, XTL | 19.95 |
| 7216AIJI | 8-Digit Univ. Counter C.A. | 32.00 |
| 7216DIPI | 8-Digit Freq. Counter C.A. | 26.95 |
| 7216CIJI | 8-Digit Univ. Counter C.C. | 21.95 |
| 7217IJI | 4-Digit LED Up/Down Counter | 12.95 |
| 7218CIJI | 8-Digit Univ. LED Drive | 10.95 |
| 7224IPL | LCD 4½ Digit Up Counter DRI | 11.25 |
| 7226AIJL | 8-Digit Univ. Counter | 31.95 |
| 7226AEV/Kit* | 5 Function Counter Chip, XTL | 74.95 |
| 7240IJE | CMOS Bin Prog. Timer/Counter | 4.95 |
| 7242IJA | CMOS Divide-by-256 RC Timer | 2.05 |
| 7250IJE | CMOS BCD Prog. Timer/Counter | 6.00 |
| 7260IJE | CMOS BCD Prog. Timer/Counter | 5.25 |
| 7555IPA | CMOS 555 Timer (8 pin) | 1.45 |
| 7556IPD | CMOS 556 Timer (14 pin) | 2.20 |
| 7611BCPA | CMOS Op Amp Comparator 5MV | 2.25 |
| 7612BCPA | CMOS Op Amp Ext. Cmvr. 5MV | 2.95 |
| 7621BCPA | CMOS Dual Op Amp Comp. 5MV | 3.95 |
| 7631CCPE | CMOS Tri Op Amp Comp. 10MV | 5.35 |
| 7641CCPD | CMOS Quad Op Amp Comp. 10MV | 7.50 |
| 7642CCPD | CMOS Quad Op Amp Comp. 10MV | 7.50 |
| 7660CPA | Voltage Converter | 2.95 |
| 8069CCQ | 50ppm Band—GAP Volt Ref. Diode | 2.50 |
| 8211CPA | Volt Ref/Indicator | 2.50 |
| 8212CPA | Volt Ref/Indicator | 2.50 |

* INTERSIL'S EVALUATION KITS

## 74C

| | | | | | |
|---|---|---|---|---|---|
| 74C00 | .39 | 74C106 | .75 | 74C195 | 1.59 |
| 74C02 | .39 | 74C107 | 1.89 | 74C221 | 1.95 |
| 74C04 | .39 | 74C151 | 2.95 | 74C240 | 2.25 |
| 74C08 | .39 | 74C154 | 3.95 | 74C244 | 2.25 |
| 74C10 | .39 | 74C157 | 2.25 | 74C373 | 2.49 |
| 74C14 | .75 | 74C160 | 1.69 | 74C374 | 2.59 |
| 74C20 | .39 | 74C161 | 1.60 | 74C901 | .89 |
| 74C30 | .39 | 74C162 | 1.49 | 74C903 | 1.15 |
| 74C42 | 1.39 | 74C163 | 1.69 | 74C911 | 10.95 |
| 74C48 | 1.95 | 74C164 | 1.59 | 74C912 | 10.95 |
| 74C73 | .79 | 74C173 | 1.39 | 74C915 | 1.69 |
| 74C74 | .79 | 74C174 | 1.39 | 74C917 | 10.95 |
| 74C85 | 1.95 | 74C175 | 1.39 | 74C922 | 5.49 |
| 74C86 | .99 | 74C192 | 1.69 | 74C923 | 5.75 |
| 74C89 | 6.95 | 74C193 | 1.69 | 74C925 | 7.50 |
| 74C90 | 1.29 | | | 74C926 | 7.50 |
| 74C93 | 1.29 | | | 80C95 | .79 |
| 74C95 | 1.59 | | | 80C97 | .79 |

## LINEAR

| | | | | | |
|---|---|---|---|---|---|
| LH0002CN | 6.85 | LM340T-5 | 1.25 | NE570N | 4.95 |
| LM10CLH | 4.50 | LM340T-12 | 1.25 | LM702H | .79 |
| LM11CLH | 4.75 | LM340T-15 | 1.25 | LM703CN | .89 |
| LH0070-OH | 6.05 | LM341P-5 | .75 | LM709N | .29 |
| TL071CP | .79 | LM341P-12 | .75 | LM710N | .79 |
| TL072CP | 1.39 | LM341P-15 | .75 | LM711N | .79 |
| TL074CN | 2.49 | LM342P-5 | .69 | LM723N | .69 |
| LH0082CD | 35.80 | LM342P-12 | .69 | LM733N | 1.00 |
| TL082CP | 1.19 | LM342P-15 | .69 | LM739N | 1.19 |
| TL084CN | 2.19 | LM348N | 1.25 | LM741CN | .35 |
| LH0094CD | 36.80 | LM350K | 5.75 | MC1741SCG | 3.00 |
| LM300H | .99 | LF351N | .60 | LM747N | .79 |
| LM301CN | .35 | LF353N | 1.00 | LM748N | .59 |
| LM302H | 1.95 | LF355N | 1.10 | LM1014N | 2.75 |
| LM304H | 1.95 | LF356N | 1.10 | LM1310N | 1.95 |
| LM305H | .99 | LM358N | 1.00 | LM1458CN | .59 |
| LM307CN | .45 | LM359N | 1.79 | LM1488N | 1.25 |
| LM308CN | 1.00 | LM370N | 4.49 | LM1489N | 1.25 |
| LM309H | 1.95 | LM373N | 3.25 | LM1496N | 1.95 |
| LM309K | 1.25 | LM377N | 2.95 | LM1556V | 1.75 |
| LM310CN | 1.75 | LM380N | 1.25 | LM1800N | 2.95 |
| LM311H | .90 | LM381N | 1.95 | LM1877N-9 | 3.25 |
| LM312H | 2.49 | LM382N | 1.79 | LM1889N | 3.20 |
| LM317MP | 1.15 | LM384N | 1.95 | LM1896N | 1.75 |
| LM317T | 1.75 | LM386N-3 | 1.29 | LM2002T | 1.49 |
| LM317K | 3.95 | LM387N | 1.45 | LM2877P | 2.05 |
| LM318CN | 1.95 | LM389N | 1.35 | LM2878P | 2.25 |
| LM319N | 1.95 | LM392N | .69 | LM2896P-1 | 2.25 |
| LM320K-5 | 1.35 | LF398N | 4.00 | LM3189N | 2.95 |
| LM320K-12 | 1.35 | LM399H | 5.00 | LM3900N | .69 |
| LM320K-15 | 1.35 | TL494CN | 4.49 | LM3905CN | 1.25 |
| LM320T-5 | 1.25 | TL496CP | 1.75 | LM3909N | 1.15 |
| LM320T-12 | 1.25 | NE510A | 6.00 | LM3914N | 3.95 |
| LM320T-15 | 1.25 | NE529A | 4.95 | LM3915N | 3.95 |
| LM323K-5 | 5.95 | NE531H | 3.95 | LM3916N | 3.95 |
| LM324N | .99 | NE536H | 6.00 | RC4136N | 1.25 |
| LM329DZ | .65 | NE540H | 6.00 | RC4151NB | 3.95 |
| LM331N | 3.95 | NE544N | 4.95 | RC4194TK | 5.95 |
| LM334Z | 1.30 | NE550A | 1.30 | RC4195TK | 5.49 |
| LM335Z | 1.40 | NE555V | .39 | KB4428 | 4.25 |
| LM336Z | 1.75 | LM556N | .99 | KB4429 | 5.95 |
| LM337T | 1.95 | NE564N | 3.95 | LM4500A | 3.25 |
| LM337MP | 1.15 | LM565N | 1.25 | ICL8038B | 4.95 |
| LM338K | 6.95 | LM566CN | 1.95 | LM13080N | 1.29 |
| LM339N | .99 | LM567V | 1.25 | LM13600N | 1.49 |
| LM340K-5 | 1.35 | | | 75138N | 1.95 |
| LM340K-12 | 1.35 | | | 75450N | .89 |
| LM340K-15 | 1.35 | | | 75451CN | .39 |

## CAPACITOR CORNER

### 50 VOLT CERAMIC DISC CAPACITORS

| Value | 1-9 | 10-99 | 100+ | Value | 1-9 | 10-99 | 100+ |
|---|---|---|---|---|---|---|---|
| 10 pf | .08 | .06 | .05 | .001µF | .08 | .06 | .05 |
| 22 pf | .08 | .06 | .05 | .0047µF | .08 | .06 | .05 |
| 47 pf | .08 | .06 | .05 | .01µF | .08 | .06 | .05 |
| 100 pf | .08 | .06 | .05 | .022µF | .09 | .07 | .06 |
| 220 pf | .08 | .06 | .05 | .047µF | .09 | .07 | .06 |
| 470 pf | .08 | .06 | .05 | .1µF | .15 | .12 | .10 |

### 100 VOLT MYLAR FILM CAPACITORS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| .001mf | .12 | .10 | .07 | .022mf | .13 | .11 | .08 |
| .0022mf | .12 | .10 | .07 | .047mf | .21 | .17 | .13 |
| .0047mf | .12 | .10 | .07 | .1mf | .27 | .23 | .17 |
| ,01mf | .12 | .10 | .07 | .22mf | .33 | .27 | .22 |

### +20% DIPPED TANTALUMS (Solid) CAPACITORS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| .1/35V | .39 | .34 | .29 | 1.5/35V | .41 | .37 | .29 |
| .15/35V | .39 | .34 | .29 | 2.2/35V | .51 | .45 | .34 |
| .22/35V | .39 | .34 | .29 | 3.3/25V | .53 | .47 | .37 |
| .33/35V | .39 | .34 | .29 | 4.7/25V | .63 | .56 | .45 |
| .47/35V | .39 | .34 | .29 | 6.8/25V | .79 | .69 | .55 |
| .68/35V | .39 | .34 | .29 | 15/25V | 1.39 | 1.25 | .95 |
| 1.0/35V | .39 | .34 | .29 | 22/6V | .79 | .69 | .55 |

### MINI. ALUMINUM ELECTROLYTIC CAPACITORS

| Axial Lead | | | | Radial Lead | | | |
|---|---|---|---|---|---|---|---|
| .47/50V | .16 | .14 | .10 | .47/25V | .15 | .13 | .12 |
| 1.0/50V | .19 | .16 | .12 | .47/50V | .16 | .14 | .13 |
| 3.3/50V | .17 | .15 | .11 | 1.0/16V | .15 | .13 | .12 |
| 4.7/25V | .18 | .15 | .11 | 1.0/25V | .16 | .14 | .13 |
| 10/25V | .18 | .15 | .11 | 1.0/50V | .17 | .15 | .14 |
| 10/50V | .19 | .16 | .12 | 4.7/16V | .15 | .13 | .12 |
| 22/25V | .19 | .16 | .12 | 4.7/25V | .16 | .14 | .13 |
| 22/50V | .24 | .20 | .18 | 4.7/50V | .17 | .15 | .14 |
| 47/25V | .25 | .21 | .19 | 10/16V | .15 | .13 | .12 |
| 47/50V | .29 | .25 | .23 | 10/25V | .16 | .14 | .13 |
| 100/25V | .28 | .24 | .22 | 10/50V | .17 | .15 | .14 |
| 100/50V | .41 | .37 | .34 | 47/50V | .25 | .21 | .19 |
| 220/25V | .39 | .34 | .33 | 100/16V | .21 | .17 | .14 |
| 220/50V | .49 | .45 | .41 | 100/25V | .25 | .23 | .21 |
| 470/25V | .54 | .49 | .45 | 100/50V | .37 | .34 | .31 |
| 1000/16V | .79 | .69 | .61 | 220/16V | .25 | .21 | .19 |
| 2200/16V | .89 | .79 | .69 | 470/25V | .35 | .31 | .27 |

# Quest ELECTRONICS

✓44

P.O. Box 4430S
Santa Clara, CA 95054
Will calls: 2322 Walsh Ave.
(408) 988-1640

**Same day shipment.** First line parts only. Factory tested. Guaranteed money back. Quality IC's and other components at factory prices.

## INTEGRATED CIRCUITS

| 7400TTL | |
|---|---|
| 7400N | 19 |
| 7402N | 20 |
| 7404N | 25 |
| 7409N | 23 |
| 7410N | 20 |
| 7414N | 70 |
| 7420N | 20 |
| 7422N | 39 |
| 7430N | 20 |
| 7442N | 58 |
| 7445N | 74 |
| 7447N | 58 |
| 7448N | 77 |
| 7450N | 20 |
| 7474N | 35 |
| 7475N | 49 |
| 7485N | 88 |
| 7489N | 1 85 |
| 7490N | 43 |
| 7492N | 43 |
| 7493N | 43 |
| 7495N | 69 |
| 74100N | 1 20 |
| 74107N | 35 |
| 74121N | 34 |
| 74123N | 59 |
| 74125N | 45 |
| 74145N | 77 |
| 74150N | 1 20 |
| 74151N | 69 |
| 74154N | 2 00 |
| 74157N | 69 |
| 74161N | 87 |
| 74162N | 1 25 |
| 74163N | 87 |
| 74174N | 96 |
| 74175N | 95 |
| 74190N | 1 15 |
| 74192N | 87 |
| 74193N | 85 |
| 74221N | 2 75 |
| 74298N | 1 65 |
| 74365N | 89 |
| 74366N | 89 |
| 74367N | 89 |

| 74LS00 TTL | |
|---|---|
| 74LS00N | 35 |
| 74LS02N | 35 |
| 74LS04N | 55 |
| 74LS05N | 40 |
| 74LS08N | 45 |
| 74LS10N | 45 |
| 74LS13N | 55 |
| 74LS14N | 1 25 |
| 74LS20N | 45 |
| 74LS22N | 45 |
| 74LS28N | 45 |
| 74LS30N | 45 |
| 74LS33N | 75 |
| 74LS38N | 75 |
| 74LS74N | 1 25 |
| 74LS75N | 1 00 |
| 74LS90N | 1 00 |
| 74LS93N | 1 00 |
| 74LS95N | 1 10 |
| 74LS107N | 65 |
| 74LS112N | 65 |
| 74LS113N | 45 |
| 74LS132N | 89 |
| 74LS136N | 65 |
| 74LS151N | 1 10 |
| 74LS155N | 1 10 |
| 74LS157N | 1 10 |
| 74LS162N | 1 65 |
| 74LS163N | 1 65 |
| 74LS174N | 2 00 |
| 74LS190N | 1 25 |
| 74LS221N | 2 50 |
| 74LS258N | 1 60 |
| 74LS367N | 1 65 |

| LINEAR | |
|---|---|
| CA3045 | 90 |
| CA3046 | 1 10 |
| CA3081 | 1 80 |
| CA3082 | 1 90 |
| CA3089 | 2 95 |
| LM301AN AH | 35 |
| LM305H | 87 |
| LM307N | 35 |
| LM308N | 1 00 |
| LM309K | 1 50 |
| LM311H N | 90 |
| LM317T K | 3 75 |
| LM318 | 1 35 |
| LM320K 5 | 1 50 |
| LM323K-5 | 5 95 |
| LM320K 12 | 1 50 |
| LM320K 15 | 1 50 |
| LM320T-5 | 1 35 |
| LM320T-8 | 1 35 |
| LM320T 12 | 1 35 |
| LM320T 15 | 1 35 |
| LM324N | 1 40 |
| LM339N | 1 00 |
| LM340K-5 | 1 35 |
| LM340K 8 | 1 35 |
| LM340K-12 | 1 35 |
| LM340K 15 | 1 35 |
| LM340K-24 | 1 35 |
| LM340T-5 | 1 25 |
| LM340T-8 | 1 25 |
| LM340T-12 | 1 25 |
| LM340T-15 | 1 25 |
| LM340T-18 | 1 25 |
| LM340T-24 | 1 25 |
| LM350 | 7 50 |
| LM377 | 3 50 |
| LM379 | 5 00 |
| LM380N | 1 00 |
| LM381 | 1 60 |
| LM382 | 1 60 |
| LM703H | 65 |
| LM709H | 28 |
| LM723H N | 50 |
| LM733N | 85 |
| LM741CH | 35 |
| LM741N | 38 |
| LM747H N | 75 |
| LM748N | 35 |
| LM1303N | 1 75 |
| LM1304 | 1 10 |
| LM1305 | 1 27 |
| LM1307 | 2 00 |
| LM1310 | 2 75 |
| LM1458 | 47 |
| LM1812 | 7 50 |
| LM1889 | 3 00 |
| LM2111 | 1 75 |
| LM2902 | 2 25 |
| LM3900N | 60 |
| LM3905 | 1 75 |
| LM3909N | 95 |
| MC1458V | 50 |
| NE550N | 1 00 |
| NE555V | 39 |
| NE556A | 85 |
| NE565A | 1 00 |
| NE566V | 1 50 |
| NE567V | 1 00 |
| NE5708 | 4 75 |
| 78L05 | 60 |
| 78L08 | 60 |
| 78M05 | 85 |
| 75108 | 1 75 |
| 75491CN | 50 |
| 75492CN | 55 |
| 75494CN | 89 |

| A to D CONVERTER | |
|---|---|
| 8038B | 4 50 |
| 8700CJ | 13 95 |
| 8701CN | 22 00 |
| 8750CJ | 13 95 |
| LD130 | 9 95 |
| 9400CJV F | 7 40 |
| ICL7103 | 9 50 |
| ICL7107 | 14 25 |

| CMOS | |
|---|---|
| CD4000 | 25 |
| CD4001 | 35 |
| CD4002 | 35 |
| CD4006 | 1 10 |
| CD4007 | 35 |
| CD4008 | 28 |
| CD4009 | 45 |
| CD4010 | 45 |
| CD4011 | 35 |
| CD4012 | 28 |
| CD4013 | 47 |
| CD4014 | 1 25 |
| CD4015 | 1 00 |
| CD4016 | 55 |
| CD4017 | 1 05 |
| CD4018 | 94 |
| CD4019 | 45 |
| CD4020 | 1 02 |
| CD4021 | 1 35 |
| CD4022 | 1 10 |
| CD4023 | 28 |
| CD4024 | 75 |
| CD4025 | 28 |
| CD4026 | 2 50 |
| CD4027 | 66 |
| CD4028 | 85 |
| CD4029 | 1 35 |
| CD4030 | 45 |
| CD4035 | 1 35 |
| CD4040 | 1 35 |
| CD4042 | 85 |
| CD4043 | 85 |
| CD4044 | 85 |
| CD4046 | 1 67 |
| CD4049 | 45 |
| CD4050 | 49 |
| CD4051 | 1 13 |
| CD4060 | 1 42 |
| CD4066 | 71 |
| CD4068 | 40 |
| CD4069 | 40 |
| CD4070 | 50 |
| CD4071 | 45 |
| CD4072 | 45 |
| CD4073 | 45 |
| CD4075 | 45 |
| CD4076 | 1 65 |
| CD4078 | 40 |
| CD4081 | 35 |
| CD4082 | 35 |
| CD4116 | 47 |
| CD4490 | 5 50 |
| CD4507 | 1 00 |
| CD4508 | 4 25 |
| CD4510 | 1 02 |
| CD4511 | 94 |
| CD4515 | 2 52 |
| CD4516 | 1 10 |
| CD4518 | 1 02 |
| CD4520 | 1 02 |
| CD4527 | 1 51 |
| CD4528 | 79 |
| CD4553 | 3 50 |
| CD4566 | 2 25 |
| CD4583 | 2 35 |
| CD4585 | 1 10 |
| CD40192 | 3 00 |
| 74C00 | 35 |
| 74C04 | 40 |
| 74C10 | 35 |
| 74C14 | 1 95 |
| 74C20 | 35 |
| 74C30 | 35 |
| 74C48 | 2 25 |
| 74C74 | 85 |
| 74C76 | 1 75 |
| 74C90 | 1 75 |
| 74C93 | 1 75 |
| 74C154 | 3 00 |
| 74C160 | 2 00 |
| 74C175 | 1 35 |
| 74C192 | 2 25 |
| 74C221 | 2 50 |
| 74C905 | 6 00 |
| 74C906 | 75 |
| 74C914 | 1 95 |
| 74C922 | 6 00 |
| 74C923 | 6 00 |
| 74C925 | 7 50 |
| 74C926 | 6 95 |
| 74C927 | 6 95 |

| INTERFACE | |
|---|---|
| 8095 | 65 |
| 8096 | 65 |
| 8097 | 65 |
| 8098 | 65 |
| 8T09 | 1 25 |
| 8T10 | 4 50 |
| 8T13 | 3 00 |
| 8T20 | 5 50 |
| 8T23 | 3 10 |
| 8T24 | 3 50 |
| 8T25 | 3 20 |
| 8T26 | 1 69 |
| 8T28 | 2 75 |
| 8T97 | 1 69 |
| 8T98 | 1 69 |

| MOS/MEMORY RAM | |
|---|---|
| 2101-1 | 2 95 |
| 2102-1 | 95 |
| 2102AL-4 | 1 34 |
| 2102AN-2L | 1 60 |
| 2104A-4 | 4 95 |
| 21078-4 | 3 75 |
| 2111-1 | 3 75 |
| 2112-2 | 3 95 |
| 2114L 300ns | 6 75 |
| 2114L 450ns | 5 95 |
| 4116 200ns | 7 95 |
| 8/4116 200ns | 49 00 |
| 2513B | 6 30 |
| MM5262 | 40 |
| MM5280 | 3 00 |
| MM5320 | 9 95 |
| MM5330 | 5 94 |
| PD411D-3 | 4 00 |
| PD411D-4 | 5 00 |
| P5101L | 8 95 |
| 4200A | 9 95 |
| 82S25 | 2 90 |
| 91L02A | 1 50 |
| HD0165-5 | 6 95 |
| MM57100 | 4 50 |
| GIAY38500-1 | 9 95 |
| MCM66751A | 9 95 |
| 9368 | 3 50 |
| 410D | 10 00 |
| 416 | 16 00 |

| CLOCKS | |
|---|---|
| MM5311 | 5 50 |
| MM5312 | 3 90 |
| MM5314 | 3 90 |
| MM5369 | 2 10 |
| MM5841 | 14 45 |
| MM5865 | 7 95 |
| CT7010 | 8 95 |
| CT7015 | 8 95 |
| MM5375AA N | 3 90 |
| MM5375AG N | 4 90 |
| 7205 | 16 50 |
| 7207 | 7 50 |
| 7208 | 15 95 |
| 7209 | 4 95 |
| DS0026CN | 3 75 |
| DS0056CN | 3 75 |
| MM53104 | 2 50 |

| MICROPROCESSOR | |
|---|---|
| 6502 | 10 95 |
| 6504 | 9 95 |
| 6522 | 9 95 |
| 6800 | 6 95 |
| 6802 | 11 95 |
| 6820 | 4 95 |
| 6850 | 5 95 |
| 8080A | 5 95 |
| 8085 | 12 95 |
| 8086 | 75 00 |
| Z80 | 9 95 |
| Z80A | 11 95 |
| 8212 | 2 90 |
| 8214 | 3 95 |
| 8216 | 2 90 |
| 8224 | 3 45 |
| 8228 | 4 95 |
| 8251 | 6 95 |
| 8253 | 15 00 |
| 8255 | 5 75 |
| 8257 | 10 95 |
| 8259 | 14 95 |
| 1802CP plas | 13 95 |
| 1802DP plas | 17 95 |
| 1861P | 11 50 |
| CDP1802CD | 28 95 |
| CDP1802D | 35 00 |
| CDP1861 | 15 95 |

| UART/FIFO | |
|---|---|
| AY5-1013 | 5 50 |
| AY5-1014 | 7 50 |
| 3341 | 6 95 |

| PROM | |
|---|---|
| 1702A | 4 95 |
| 2513B upper case | 8 75 |
| 2708 | 7 75 |
| 2716T1 | 18 00 |
| 2716 Intel | 23 00 |
| 8 2716 Intel | 160 00 |
| 2732 | 65 00 |
| 2758 | 22 50 |
| 8741A | 60 00 |
| 8748 | 65 00 |
| 8748-8 | 60 00 |
| 8755A | 55 00 |
| N82S23 | 2 95 |
| N82S123 | 6 50 |
| N82S126 | 3 75 |
| N82S129 | 8 50 |
| N82S131 | 8 50 |
| N82S136 | 8 75 |
| N82S137 | 8 75 |
| DM8577 | 2 90 |
| 8223 | 2 90 |

| CONNECTORS | |
|---|---|
| 30 pin edge | 2 50 |
| 44 pin edge | 2 75 |
| 100 pin edge | 4 50 |
| 100 pin edge WW | 5 25 |

**IC SOCKETS**

| Solder Tin Low Profile | | | |
|---|---|---|---|
| PIN | 1 UP | PIN | 1UP |
| 8 | 15 | 22 | 30 |
| 14 | 14 | 24 | 35 |
| 16 | 16 | 28 | 42 |
| 18 | 27 | 36 | 58 |
| 20 | 29 | 40 | 57 |

2 level 14 pin ww 20

**WIRE WRAP LEVEL 3**

| PIN | | PIN | |
|---|---|---|---|
| 14 | 32 | 24 | 86 |
| 16 | 33 | 28 | 1 00 |
| 18 | 57 | 40 | 1 23 |

| CRYSTALS | |
|---|---|
| 1 MHz | 4 50 |
| 2 MHz | 4 50 |
| 4 MHz | 4 25 |
| 5 MHz | 4 25 |
| 10 MHz | 4 25 |
| 18 MHz | 3 90 |
| 20 MHz | 3 90 |
| 32 MHz | 3 90 |
| 32768 Hz | 4 00 |
| 1 8432 MHz | 4 50 |
| 3 5795 MHz | 1 20 |
| 2 0100 MHz | 1 95 |
| 2 097152 MHz | 4 50 |
| 2 4576 MHz | 4 50 |
| 3 2768 MHz | 4 50 |
| 5 0688 MHz | 4 50 |
| 5 185 MHz | 4 50 |
| 5 7143 MHz | 4 50 |
| 6 5536 MHz | 4 50 |
| 14 31818 MHz | 4 25 |
| 18 432 MHz | 4 50 |
| 22 1184 MHz | 4 50 |

| KEYBOARD ENCODERS | |
|---|---|
| AY5-2376 | $12 50 |
| AY5-3600 | 17 95 |
| AY5-9100 | 10 50 |
| AY5-9200 | 16 50 |
| 74C922 | 5 50 |
| 74C923 | 5 50 |
| HD0165-5 | 6 95 |
| AY5-9400 | 10 50 |

| D Connectors RS232 | |
|---|---|
| DB25P | 3 62 |
| DB25S | 5 20 |
| Cover | 1 67 |
| DE9S | 1 95 |
| DA15P | 2 10 |
| DA15S | 3 10 |
| Complete Set | 9 50 |

| | |
|---|---|
| **Hickok 3½ Digit LED multimeter** | **74 95** |
| **Stopwatch Kit** | **26 95** |
| **Auto Clock Kit** | **17 95** |
| **Digital Clock Kit** | **14 95** |

| **8K/16K Eprom Kit** (less PROMS) | $89 00 |
|---|---|
| **Motherboard** | $39 00 |
| **Extender Board** | $15 00 |

| RESISTORS ¼ watt 5% | |
|---|---|
| 10 per type | 03 |
| 25 per type | 025 |
| 100 per type | 015 |
| 1000 per type | 012 |
| 350 piece pack 5 per type | 6 75 |
| ½ watt 5% per type | 05 |

| **Televideo Terminal** | |
|---|---|
| Model 912 | $845 00 |
| Model 920 | $945 00 |

**Tiny Basic Experimenters Kit** $10 00

**BSR Controller $39.95**
Connect your computer to the BSR Home Control System. Computer controlled ultrasonic transmitter for your BSR. Software for 1802 user

| KEYBOARDS | |
|---|---|
| 56 key ASCII keyboard kit | $67 50 |
| Fully assembled | 77 50 |
| 53 key ASCII keyboard kit | 60 00 |
| Fully assembled | 70 00 |
| Enclosure Plastic | 14 95 |
| Metal Enclosure | 29 95 |

| LEDS | |
|---|---|
| Red T018 | 15 |
| Green, Yellow T018 | 20 |
| Jumbo Red | 20 |
| Green, Orange Yellow Jumbo | 25 |
| **Cliplite LED Mounting Clips** | 8/$1 25 |

(specify red, amber, green, yellow, clear)

**CONTINENTAL SPECIALTIES in stock**
Complete line of breadboard test equip
**MAX-100 8 digit Freq. Ctr. $128.95**

**OK WIRE WRAP TOOLS in stock**
**Portable Multimeter $18.00**

Complete line of AP Products in stock

| SPECIAL PRODUCTS | |
|---|---|
| MM5865 Stopwatch Timer with 10 pg spec | 9 00 |
| PC board | 7 50 |
| **Switches** Mom Pushbutton | .27 |
| 3 pos slide | 25 |
| **Encoder** HD0165-5 | 6 95 |
| **Paratronics 100A Logic Analyzer** | **$425.00** |
| Model 10 Trigger Expander Kit | $229 00 |
| Model 150 Bus Grabber Kit | $369 00 |
| **Clock Calender Kit** | **$23.95** |
| **2.5 MHz Frequency Counter Kit** | **$37.50** |
| **30 MHz Frequency Counter Kit** | **$47.75** |

| TRANSFORMERS | |
|---|---|
| 6V 300 ma | 3 25 |
| 12 Volt 300 ma transformer | 1 25 |
| 12 6V CT 600 ma | 3 75 |
| 12V 250 ma wall plug | 2 95 |
| 12V CT 250 ma wall plug | 3 50 |
| 24V CT 400 ma | 3 95 |
| 10V 1 2 amp wall plug | 4 85 |
| 12V 6 amp | 12 95 |
| 12V 500 ma wall plug | 4 75 |
| 12V 1 amp wall plug | 6 50 |
| 10/15 VAC 8/16 VA wall plug | 9 75 |

| DISPLAY LEDS | | | |
|---|---|---|---|
| MAN1 | CA | 270 | 2 90 |
| MAN3 | CC | 125 | 39 |
| MAN72/74 | CA/CA | 300 | 1 00 |
| DL704 | CC | 300 | 1 25 |
| DL707/DL707R | CA | 300 | 1 00 |
| DL727/728 | CA/CC | 500 | 1 90 |
| DL747/750 | CA/CC | 600 | 1 95 |
| DL750 | CC | 600 | 1 95 |
| FND359 | CC | 357 | 70 |
| FND500/507 | CC/CA | 500 | 1 35 |
| FND503/510 | CC/CA | 500 | 90 |
| FND800/807 | CC/CA | 800 | 2 20 |
| 3 digit Bubble | | | 60 |
| 4 digit Bubble | | | 80 |
| DG8 Fluorescent | | | 1 75 |
| DG10 Fluorescent | | | 1 75 |
| 10 digit display | | | 1 25 |
| 7520 Clairex photocells | | | 39 |
| TIL311 Hex | | | 9 50 |
| MAN3640 | CC | 30 | 1 10 |
| MAN4610 | CA | 40 | 1 20 |
| MAN4640 | CC | 40 | 1 20 |
| MAN4710 | CA | 40 | 95 |
| MAN4740 | CC | 40 | 1 20 |
| MAN6640 | CC | 56 | 2 95 |
| MAN6710 | CA | 60 | 1 35 |
| MAN6740 | CC | 60 | 1 35 |

| | |
|---|---|
| **MA1002A** | **8.95** |
| **MA1002E** | **8.95** |
| **MA1012A** | **8.95** |
| **102P3 transformer** | **2.25** |
| **MA1012A Transformer** | **2.25** |


## RCA Cosmac 1802 Super Elf Computer $106.95

Compare features before you decide to buy any other computer. There is no other computer on the market today that has all the desirable benefits of the **Super Elf** for so little money. The Super Elf is a small single board computer that does many **big** things. It is an excellent computer for training and for learning programming with its machine language and yet it is easily **expanded with additional memory, Full Basic, ASCII Keyboards, video character generation, etc.**

Before you buy another small computer, see if it includes the following features: ROM monitor; State and Mode displays; Single step; Optional address displays; Power Supply; Audio Amplifier and Speaker; Fully socketed for all IC's; Real cost of in warranty repairs; Full documentation.

The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the **unique Quest** address and data bus displays **before, during** and **after** executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on 8 LED indicators.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step**. Large, on board displays provide output and optional **high and low address**. There is a 44 pin standard connector slot for PC cards and a 50 pin connector slot for the Quest Super Expansion Board. Power supply and sockets for **all** IC's are included in the price plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info. including a series of lessons to help get you started and a music program and graphics target game. Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and R&D.

Remember, other computers only offer Super Elf features at additional cost or not at all. **Compare before you buy. Super Elf Kit $106.95. High address option $8.95, Low address option $9.95. Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95.** All metal Expansion Cabinet, painted and silk screened, with room for 5 S-100 boards and power supply **$57.00. NiCad Battery Memory Saver Kit $6.95.** All kits and options also completely assembled and tested.

**Questdata**, a software publication for 1802 computer users is available by subscription for $12.00 per 12 issues. Single issues $1.50. Issues 1-12 bound $16.50.

Tiny Basic Cassette **$10.00,** on ROM **$38.00,** original Elf kit board **$14.95. 1802 software;** Moews Video Graphics **$3.50.** Games and Music **$3.00,** Chip 8 Interpreter **$5.50.**

## Super Expansion Board with Cassette Interface $89.95

This is truly an astounding value! This board has been designed to allow **you** to decide how you want it optioned. **The Super Expansion Board comes with 4K of low power RAM** fully addressable anywhere in 64K with built-in memory protect and a **cassette interface**. Provisions have been made for all other options on the same board and it fits neatly into the hardwood cabinet alongside the **Super Elf.** The board includes slots for up to 6K of **EPROM** (2708, 2758, 2716 or TI 2716) and is **fully socketed.** EPROM can be used for the monitor and Tiny Basic or other purposes.

**A 1K Super ROM Monitor $19.95** is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatable cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports** with **full handshake**. They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two **S-100** slots for static RAM or video boards. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50.** A **50 pin connector set** with ribbon cable is available at $15.25 for easy connection between the **Super Elf** and the **Super Expansion Board.**

**Power Supply Kit** for the complete system (see Multi-volt Power Supply).

## Announcing Quest Super Basic— *SECOND GENERATION*

A new enhanced version of **Super Basic** now available. Quest was the first company worldwide to ship a full size Basic for 1802 Systems. A complete function **Super Basic** by **Ron Cenker** including floating point capability with scientific notation (number range $\pm .17E^{38}$), 32 bit integer $\pm 2$ billion; multi dim arrays, string arrays; string manipulation; cassette I/O; save and load, basic, data and machine language programs; and over 75 statements, functions and operations.

**Enhancements include increased speed, built-in provisions for Stringy Floppy, Floppy Disc, Printer Driver, I/O, user definable command library and statement renumbering.**

**Easily adaptable to most 1802 systems. Requires 16K RAM minimum for Basic and user programs. Source listing for both Serial and Parallel I/O included.**

**Super Basic on Cassette $40.00.**

### PROM Eraser

assembled. 25 PROM capacity **$37.50** (with timer **$69.50**). 6 PROM capacity OSHA/UL version **$69.50** (with timer **$94.50**).

### Z80 Microcomputer

16 bit I/O, 2 MHz clock, 2K RAM, ROM Breadboard space. Excellent for control. Bare Board **$28.50.** Full Kit **$99.00.** Monitor **$20.00.** Power Supply Kit **$35.00. Tiny Basic $30.00**

### S-100 Computer Boards

| | |
|---|---|
| 8K Static Godbout Econo IIA Kit | 145.00 |
| 16K Static Godbout Econo XIV Kit | 285.00 |
| 24K Static Godbout Econo VIIA-24 Kit | 435.00 |
| 32K Static Godbout Econo X-32 Kit | 575.00 |
| 16K Dynamic RAM Kit | 199.00 |
| 32K Dynamic RAM Kit | 310.00 |
| 64K Dynamic RAM Kit | 470.00 |
| Video Interface Kit | **$135.00** |

### 80 IC Update Master Manual $55.00

Comp. IC data selector, 2700 pg. master reference guide. Over 51,000 cross references. Free update service through 1980. Domestic postage $3.50.

### Modem Kit $60.00

State of the art, orig., answer. No tuning necessary. 103 compatible 300 baud. Inexpensive acoustic coupler plans included.

### LRC 7000 + Printer $389.00

40/20 column dot matrix impact, std. paper. Interface all personal computers.

64/40/32/20 version **$405.00.** Optional cables available.

**LRC 7000 printer interface cable for Super Elf with software $26.00**

### NiCad Battery Fixer/Charger Kit

Opens shorted cells that won't hold a charge and then charges them up, all in one kit w/full parts and instructions. **$7.25**

### Rockwell AIM 65 Computer

6502 based single board with full ASCII keyboard and 20 column thermal printer. 20 char. alphanumeric display. ROM monitor, fully expandable. **$375.00.** 4K version **$450.00.** 4K Assembler **$85.00,** 8K Basic Interpreter **$100.00.**

Special small power supply for AIM65 assem. in frame **$54.00.** Complete AIM65 in thin briefcase with power supply **$499.00.** Molded plastic enclosure to fit both AIM65 and power supply **$47.50.** Special Package Price: 4K AIM, 8K Basic, power supply, cabinet **$599.00**

AIM65/KIM/VIM/Super Elf 44 pin expansion board; 3 female and 1 male bus. Board plus 3 connectors **$22.95.**

### 60 Hz Crystal Time Base Kit $4.40

Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy.

### Video Modulator Kit $8.95

Convert TV set into a high quality monitor w/o affecting usage. Comp. kit w/full instruc.

### Multi-volt Computer Power Supply

8v 5 amp, ±18v .5 amp, 5v 1.5 amp, −5v .5 amp, 12v .5 amp, −12v option. ±5v, ±12v are regulated. Basic Kit **$29.95.** Kit with chassis and all hardware **$43.95.** Add $4.00 shipping. Kit of hardware **$14.00.** Woodgrain case **$10.00.** $1.50 shipping.

### Gremlin Color Video Kit $69.95

32 x 16 alpha/numerics and graphics; up to 8 colors with 6847 chip; 1K RAM at E000. Plugs into Super Elf 44 pin bus. No high res. graphics. On board RF Modulator Kit **$4.95**

### 1802 16K Dynamic RAM Kit $149.00

Expandable to 32K. Hidden refresh w/clocks up to 4 MHz w/no wait states. Addl. 16K RAM **$63.00**

Super Elf 44 pin expansion board; 3 female and 1 male bus. Board plus 3 connectors **$22.95**

| | |
|---|---|
| **Tiny Basic Extended on Cassette** | **$15.00** |

**(added commands include Stringy, Array, Cassette I/O etc.)**

| | |
|---|---|
| **S-100 4-Slot Expansion** | **$ 9.95** |
| **Super Monitor VI.I Source Listing** | **$15.00** |

### Elf II Adapter Kit $24.95

Plugs into Elf II providing Super Elf 44 and 50 pin plus S-100 bus expansion. (With Super Expansion). High and low address displays, state and mode LED's optional **$18.00.**

### Super Color S-100 Video Kit $129.95

Expandable to 256 x 192 high resolution color graphics. 6847 with all display modes computer controlled. Memory mapped. 1K RAM expandable to 6K. S-100 bus 1802, 8080, 8085, Z80 etc.

| | |
|---|---|
| **Editor Assembler** | **$25.00** |

**(Requires minimum of 4K for E/A plus user source)**

| | |
|---|---|
| **1802 Tiny Basic Source listing** | **$19.00** |
| **Super Monitor V2.0/2.1 Source Listing** | **$20.00** |

**TERMS: $5.00 min. order U.S. Funds. Calif residents add 6% tax.
$10.00 min. order BankAmericard and Master Charge and COD. $1.00 insurance optional.
Shipping charges will be added on charge cards.**

**FREE: Send for your copy of our NEW 1980 QUEST CATALOG. Include 48¢ stamp.**

✓ *Reader Service—see page 257*

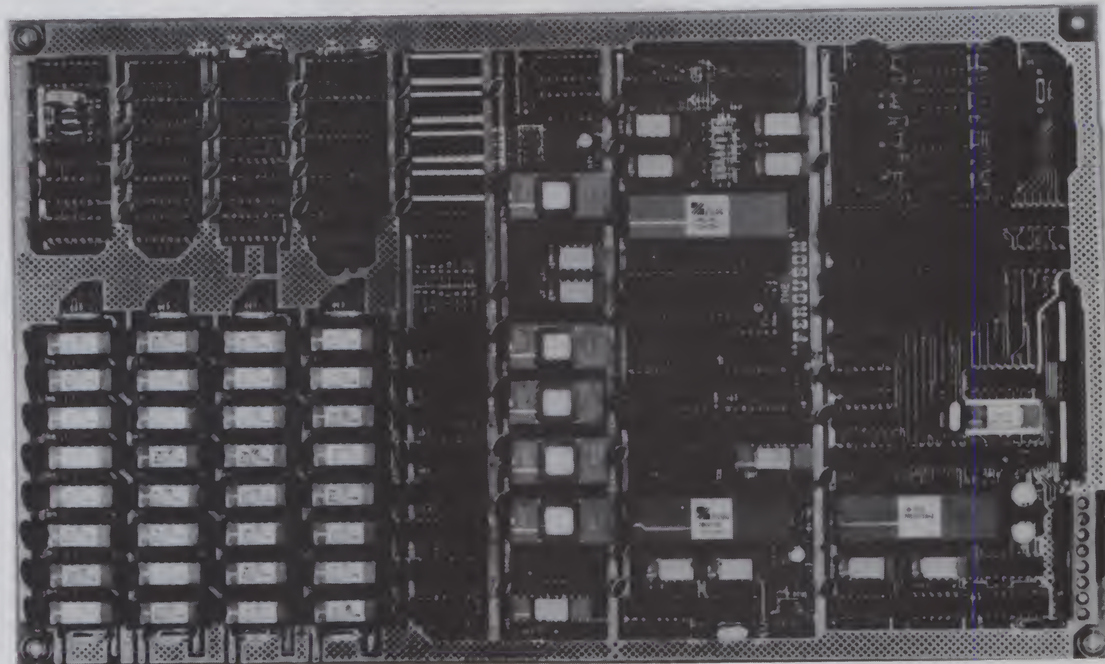
# "THE BIG BOARD"

NEW! NEW!

## OEM - INDUSTRIAL - BUSINESS - SCIENTIFIC

# SINGLE BOARD COMPUTER KIT!

## Z-80 CPU! 64K RAM!



PARTIAL KIT
For All Sockets Installed
And Soldered Add $50.

U.K. AND EUROPE: CONTACT MACLIN-ZAND LTD. 38 MOUNT PLEASANT — LONDON WCIX OAP

THE FERGUSON PROJECT: Three years in the works, and maybe too good to be true. A tribute to hard headed, no compromise, high performance, American engineering! The Big Board gives you all the most needed computing features on one board at a very reasonable cost. The Big Board was designed from scratch to run the latest version of CP/M*. Just imagine all the off-the-shelf software that can be run on the Big Board without any modifications needed! Take a Big Board, add a couple of 8 inch disc drives, power supply, an enclosure, C.R.T., and you have a total Business System for about 1/3 the cost you might expect to pay.

**$649.00**** (64K KIT BASIC I/O)

SIZE: 8½ x 13¾ IN.
SAME AS AN 8 IN. DRIVE.
REQUIRES: +5V @ 3 AMPS
+ - 12V @ .5 AMPS.

FULLY SOCKETED!

## FEATURES: (Remember, all this on one board!)

### 64K RAM

Uses Industry standard 4116 RAM'S. All 64K is available to the user, our VIDEO and EPROM sections do not make holes in system RAM. Also, very special care was taken in the RAM array PC layout to eliminate potential noise and glitches.

### Z-80 CPU

Running at 2.5 MHZ. Handles all 4116 RAM refresh and supports Mode 2 INTERUPTS. Fully buffered and runs 8080 software.

### SERIAL I/O (OPTIONAL)

Full 2 channels using the Z80 SIO and the SMC 8116 Baud Rate Generator. FULL RS232! For synchronous or asynchronous communication. In synchronous mode, the clocks can be transmitted or received by a modem. Both channels can be set up for either data-communication or data-terminals. Supports mode 2 Int. Price for all parts and connectors: $85.

### BASIC I/O

Consists of a separate parallel port (Z80 PIO) for use with an ASCII encoded keyboard for input. Output would be on the 80 x 24 Video Display.

### 24 x 80 CHARACTER VIDEO

With a crisp, flicker-free display that looks extremely sharp even on small monitors. Hardware scroll and full cursor control. Composite video or split video and sync. Character set is supplied on a 2716 style ROM, making customized fonts easy. Sync pulses can be any desired length or polarity. Video may be inverted or true. 5 x 7 Matrix - Upper & Lower Case

### FLOPPY DISC CONTROLLER

Uses WD1771 controller chip with a TTL Data Separator for enhanced reliability. IBM 3740 compatible. Supports up to four 8 inch disc drives. Directly compatible with standard Shugart drives such as the SA800 or SA801. Drives can be configured for remote AC off-on. Runs CP/M* 2.2.

### TWO PORT PARALLEL I/O (OPTIONAL)

Uses Z-80 PIO. Full 16 bits, fully buffered, bi-directional. User selectable hand shake polarity. Set of all parts and connectors for parallel I/O: $29.95

### REAL TIME CLOCK (OPTIONAL)

Uses Z-80 CTC. Can be configured as a Counter on Real Time Clock. Set of all parts: $14.95

### SYSTEM COMPARISON

| | |
|---|---|
| 64K RAM KIT | $370.00 |
| 80 x 24 Video Kit | 365.00 |
| Floppy Disk Controller Kit | 235.00 |
| Z-80 CPU Kit | 185.95 |
| SER & PAR. I/O | 129.95 |
| S-100 Mother Board | 45.00 |
| SUB TOTAL | $1330.90 |

Talk about bangs per buck! The prices shown for S100 kits were taken from the July 1980 BYTE. This will give some basis for comparison between the Big Board and a similar system implementation on the S100 Buss.

### CP/M* 2.2 FOR BIG BOARD

The popular CP/M* D.O.S. modified by MICRONIX SYSTEMS to run on Big Board is available for $150.00.

### PC BOARD

Blank PC Board with Rom Set and Full Documentation. $195.00

### PFM 3.0 2K SYSTEM MONITOR

The real power of the Big Board lies in its PFM 3.0 on board monitor. PFM commands include: Dump Memory, Boot CP/M*, Copy, Examine, Fill Memory, Test Memory, Go To, Read and Write I/O Ports, Disc Read (Drive, Track, Sector), and Search. PFM occupies one of the four 2716 EPROM locations provided.

Z-80 is a Trademark of Zilog.

# Digital Research Computers
(OF TEXAS)

P.O. BOX 401565 • GARLAND, TEXAS 75040 • (214) 271-3538

**TERMS:** Initial shipments will be made approximately 3 to 5 weeks after we receive your order. VISA, MC, cash accepted. We will accept COD's (for the Big Board only) with a $75 deposit. Balance UPS COD. The $75 deposit assures your place in line for the initial production run of Big Board.

*TRADEMARK OF DIGITAL RESEARCH. NOT ASSOCIATED WITH DIGITAL RESEARCH OF CALIFORNIA, THE ORIGINATORS OF CPM SOFTWARE
**1 TO 4 PIECE DOMESTIC USA PRICE.

# DIGITAL RESEARCH COMPUTERS
(214) 271-3538

## 32K S-100 EPROM CARD
**NEW!**

**$74.95**
KIT

**USES 2716's**

**Blank PC Board - $34**

**ASSEMBLED & TESTED**
**ADD $30**

**SPECIAL: 2716 EPROM's (450 NS) Are $14.95 EA. With Above Kit.**

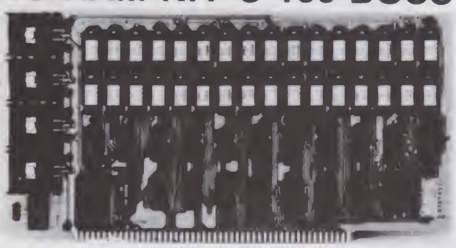
KIT FEATURES:
1. Uses +5V only 2716 (2Kx8) EPROM's.
2. Allows up to 32K of software on line!
3. IEEE S-100 Compatible.
4. Addressable as two independent 16K blocks.
5. Cromemco extended or Northstar bank select.
6. On board wait state circuitry if needed.
7. Any or all EPROM locations can be disabled.
8. Double sided PC board, solder-masked, silk-screened.
9. Gold plated contact fingers.
10. Unselected EPROM's automatically powered down for low power.
11. Fully buffered and bypassed.
12. Easy and quick to assemble.

## 16K DYNAMIC RAM PARTIALS
LOOK! **INTEL 2108 8K X 1 RAMS** LOOK!
**8 FOR $9.95 32 FOR $35**
**FACTORY PRIME!**

Huge special purchase of INTEL Dynamic RAM's. These are 2108-4, 300NS, 8K, Ceramic DIP. The 2108 is the INTEL 2116 (16K) tested for either upper or lower 8K only. These are factory prime. Full Spec. See INTEL 1978 Cat. for details or Memory Design Handbook for application data. Both IMSAI and EXTENSYS did mfg. S-100 RAM boards using these devices. — P.S. These devices will not work in the SD EPANDORAM™. Please specify upper or lower 8K. (S1626 or S1627). A super easy RAM to interface to a Z80, 16 PIN DIP

**FOR 4MHZ** PRICE CUT! **LOW POWER - 300NS** **8 FOR $37.50**
## 2114 RAM SALE!
4K STATIC RAM'S. MAJOR BRAND, NEW PARTS.
These are the most sought after 2114's, LOW POWER and 300NS FAST.
**8 FOR $37.50**

## 16K STATIC RAM KIT-S 100 BUSS



**PRICE CUT!**
**$199.95 KIT**

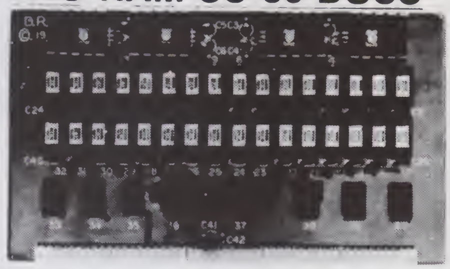
**FOR 4MHZ ADD $10**

KIT FEATURES:
1. Addressable as four separate 4K Blocks.
2. ON BOARD BANK SELECT circuitry. (Cromemco Standard!). Allows up to 512K on line!
3. Uses 2114 (450NS) 4K Static Rams.
4. ON BOARD SELECTABLE WAIT STATES.
5. Double sided PC Board, with solder mask and silk screened layout. Gold plated contact fingers.
6. All address and data lines fully buffered.
7. Kit includes ALL parts and sockets.
8. PHANTOM is jumpered to PIN 67.
9. LOW POWER: under 1.5 amps TYPICAL from the +8 Volt Buss.
10. Blank PC Board can be populated as any multiple of 4K.

BLANK PC BOARD W/DATA-$33
LOW PROFILE SOCKET SET-$12
SUPPORT IC'S & CAPS-$19.95
ASSEMBLED & TESTED-**ADD $35**

**OUR #1 SELLING RAM BOARD!**

## 16K STATIC RAM SS-50 BUSS



**PRICE CUT!**

**$210 KIT**

**FULLY STATIC!**

**FOR 2MHZ ADD $10**

**FOR SWTPC 6800 BUSS!**

**ASSEMBLED AND TESTED - $35**

KIT FEATURES:
1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Fully Bypassed
4. Double sided PC Board. Solder mask and silk screened layout
5. All Parts and Sockets included
6. Low Power: Under 1.5 Amps Typical

BLANK PC BOARD—**$30** COMPLETE SOCKET SET—**$12**
SUPPORT IC'S AND CAPS—**$19.95**

NEW! **STEREO!** NEW!
## S-100 SOUND COMPUTER BOARD

At last, an S-100 Board that unleashes the full power of two unbelievable General Instruments AY3-8910 NMOS computer sound IC's. Allows you under total computer control to generate an infinite number of special sound effects for games or any other program. Sounds can be called in BASIC, ASSEMBLY LANGUAGE, etc.

**COMPLETE KIT!**
**$84.95**
**(WITH DATA MANUAL)**

**BLANK PC BOARD W/DATA $31**

**KIT FEATURES:**
* TWO GI SOUND COMPUTER IC'S.
* FOUR PARALLEL I/O PORTS ON BOARD.
* USES ON BOARD AUDIO AMPS OR YOUR STEREO.
* ON BOARD PROTO TYPING AREA.
* ALL SOCKETS, PARTS AND HARDWARE ARE INCLUDED.
* PC BOARD IS SOLDERMASKED, SILK SCREENED, WITH GOLD CONTACTS.
* EASY, QUICK, AND FUN TO BUILD. WITH FULL INSTRUCTIONS.
* USES PROGRAMMED I/O FOR MAXIMUM SYSTEM FLEXIBILITY.

Both Basic and Assembly Language Programming examples are included.

**SOFTWARE:**
SCL™ is now available! Our Sound Command Language makes writing Sound Effects programs a SNAP! SCL™ also includes routines for Register-Examine-Modify, Memory-Examine-Modify, and Play-Memory. SCL™ is available on CP/M* compatible diskette or 2708 or 2716. Diskette - **$24.95** 2708 - **$19.95** 2716 - **$29.95**. Diskette includes the source. EPROM'S are ORG at E000H.

## 4K DYNAMIC RAM BLOWOUT!
**SAME AS INTEL 2107B!**
**4K RAMS AT AN UNBELIEVABLE 50¢ EACH!!!**

Prime, new, National Semi., 1979 date coded, full spec. parts. N.S. #MM5280-5N. Same as INTEL 2107B-4, T.I. TMS4060, NEC uPD411, etc. We bought a HUGE QTY. from a West Coast Distributor at truly DISTRESS PRICES! One of the most popular and reliable RAM's ever made. These parts have been used by almost all Major Computer Main Frame Mfg. the world over! Arranged as 4K x 1, 270 NS Access Time, 22 Pin Dip. These units DO NOT use multiplexed addressing, thus making REFRESH and other timing very simple. See INTEL MEMORY DESIGN HANDBOOK for full application notes. The NAT. SEMI. *MEMORY DATA BOOK* is available at most Radio Shack Stores. Prime units in original factory tubes!

(With Pin Out Data) **#5280-5N 4096 BITS x 1 270 NS ACCESS**
**8 FOR $4.95 32 FOR $16**
**FACTORY CASE (450 PCS) — $180**
**Sockets Special: 22 Pin Low Profile (With Purchase of 5280's) 8 FOR $1.**

## COMPUTER PARTS SPECIALS

| | |
|---|---|
| 74LS175 - .99 | 8035 Intel Single Chip CPU - **5.95** |
| 74LS240 - 1.79 | Signetics 2901 4 Bit Slice - **6.95** |
| 74LS241 - 1.79 | AMD 2903 4 Bit Super Slice - **12.50** |
| 74LS244 - 1.79 | AMD 29705 Dual Port RAM - **8.95** |
| 74LS373 - 1.99 | |

## *NEW!* G.I. COMPUTER SOUND CHIP

AY3-8910. As featured in July, 1979 BYTE! A fantastically powerful Sound & Music Generator. Perfect for use with any 8 Bit Microprocessor. Contains: 3 Tone Channels, Noise Generator, 3 Channels of Amplitude Control, 16 bit Envelope Period Control, 2-8 Bit Parallel I/O, 3 D to A Converters, plus much more! All in one 40 Pin DIP. Super easy interface to the S-100 or other busses. **$11.95** **PRICE CUT!**
**SPECIAL OFFER:** ~~$14.95~~ **each** Add $3 for 60 page Data Manual.

# Digital Research Computers
(OF TEXAS)
**P.O. BOX 401565 • GARLAND, TEXAS 75040 • (214) 271-3538**

**TERMS:** Add $1.50 postage. We pay balance. Orders under $15 add 75¢ handling. No C.O.D. We accept Visa and MasterCharge. Tex. Res. add 5% Tax. Foreign orders (except Canada) add 20% P & H. Orders over $50, add 85¢ for insurance.

**ALL SALES ARE MADE SUBJECT TO THE TERMS OF OUR 90 DAY LIMITED WARRANTY. A COPY OF THIS WARRANTY IS AVAILABLE FREE, ON REQUEST.**

***TRADEMARK OF DIGITAL RESEARCH. NOT ASSOCIATED WITH DIGITAL RESEARCH OF CALIFORNIA, THE SUPPLIERS OF CPM SOFTWARE.**

✓ Reader Service—see page 257

SEND FOR OUR FREE CATALOG

# CompuMart let's you put'em on trial

CompuMart has been selling computers by mail since 1971. Our thousands of satisfied customers rely on CompuMart for services not generally available from the others. Namely:

- Product Selection/Each product advertised by CompuMart has been evaluated by our in-house staff for best price, performance, and supplier reliability.
- Return Privilege/After receipt of our products, you are protected by CompuMart's exclusive, 10-day return priviledge good for all products except software.
- Support/Our Customer Service Dept. and expert technicians are always there to assist you by phone or at CompuMart's outlets. Our knowledgeable phone sales force can provide you with detailed information and complete product specifications.
- Phone Ordering/For added convenience, CompuMart maintains a toll-free ordering number. 1-800-343-5504.
- Phones open M T W Th F 8:30 a.m. - 7:00 p.m. Sat. 11:00 a.m. - 4:00 p.m.

# with 10 day free return

## Terminals

We've got the following Lear Siegler Terminals In Stock at prices too low to print—**Call** for quotes.

**ADM-3A** Industries favorite dumb terminal for some very smart reasons.

**ADM-3A.+** New from Lear Siegler. CALL!

**ADM-31.** The terminal that's too smart to be considered dumb.

**ADM-42.** Available with keyboard semi-intelligent terminal offering tremendous user flexibility. The optional configurations are amazing.

**NEW from Lear Siegler!**
IT's here—IT is the difference between too smart and too dumb. IT is the new Intermediate Terminal from Lear Siegler.

**Call for details.**

**Limited Time Offer**
**We've slashed our Hazeltine prices again!**

| | | |
|---|---|---|
| Hazeltine 1410 | List $850 | CompuMart **$749** |
| Hazeltine 1420 | List $995 | CompuMart **$825** |
| Hazeltine 1500 | List $1095 | CompuMart **$965** |
| Hazeltine 1510 | List $1395 | CompuMart **$1135** |
| Hazeltine 1520 | List $1585 | CompuMart **$1199** |
| Hazeltine 1552 | List $1395 | CompuMart **$1235** |

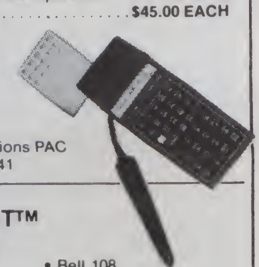
## Calculators

**A CALCULATOR, A SYSTEM, A WHOLE NEW STANDARD.**

**HEWLETT-PACKARD'S HP-41C**

**HP-41C Calculator** .......... **$288.00**

**The System**
**Memory Modules. For storing programs or up to 2,000 lines of program memory** .......... **$45.00**
"Extra Smart" Card Reader. Records programs and data back onto blank mag-cards .......... **$199.00**
The Printer. Upper and Lower case, High resolution plotting, Portable Thermal operation .......... **$355.00**
Application Modules .......... **$45.00 EACH**
Standard pac:
Statistics,
Math,
Financial &
Surveying



1/2 off Financial Decisions PAC with purchase of HP-41

**NOVATION CAT™**
**ACCOUSTIC MODEM**

- Answer Originate
- 300 Baud
- Bell 108
- Low Profile Design

**Looks good, works great! $179.00**

**NEW! D-CAT**
Direct Coupler from NOVATION **$195.00**

**Texas Instruments TI-99/4 Home Computer**
**Save $300 on this 16-Bit computer with monitor**

| | |
|---|---|
| **TI-99/4 w/Monitor** | **$825** |
| **TI-99/4 w/o Monitor** | **$725** |

## Printers

**NEW From Integral Data**
**The IDS 445 Printer**

So new all we can tell you is that it's fantastic. Priced lower than the 440 and equipped with a better print head. Advanced technology strikes!

| | |
|---|---|
| IDS 445 w/Graphics Capabilities | **$894** |
| IDS 445 w/o Graphics Capabilities | **$795** |

**FREE** Cable with your Paper Tiger.

**The IDS 460**
Since its introduction 5 months ago this printer has already proved itself. Features include: Correspondence quality printing, High-resolution graphics capability, programmable print justification—a great printer. **$1,295**

**The Omni 810 Printer from Texas Instruments**

TI Omni 820 Receive-Only (RO) Package. Includes machine-mounted paper tray and cable. A compressed print option and device forms control are standard features. **$2,155**

TI Omni 820 Keyboard Send Receive (KSR) Package Comes with fu ASCII Keyboard with numeric Key-pad and an EIA cable with autospeed select. **$2,395**

**CENTRONICS PRINTERS**
New! The incredible Model 737- Correspondence and Draft Quality Printing for Under $1,000. This is the first printer in its class to offer print quality suitable for text processing, plus the performance and application flexibility required for data processing.

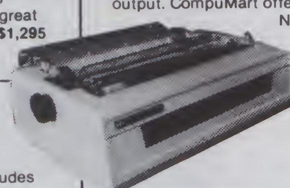
| | |
|---|---|
| 737-1 (Parallel Interface)— | **$899** |
| 737-3 (Serial Interface) | **$1,045** |

Tractor Feed Printer- Centronics' Most Popular Model. Perfect for the needs of a small business sytesm. Recommended by Apple and Radio Shack. **$1,079**

**FREE** Cable with purchase of any Centronics printer.

**NEC The First Name in Letter Quality Printers.**

CompuMart offers beautiful print quality with NEC Spinwriter terminals. The Spinwriters, both KSR and RO versions, give unsurpassed hard copy output. CompuMart offers a complete range of NEC Spin-writers — Call our expert salesforce.



Compumart will throw in a **FREE** fabric ribbon and Currier 72 element when you buy a NEC from us.

COMPUMART NOW OFFERS THE ENTIRE DEC LSI-11 PRODUCT LINE. CALL FOR PRICES & DELIVERY.

## Monitors

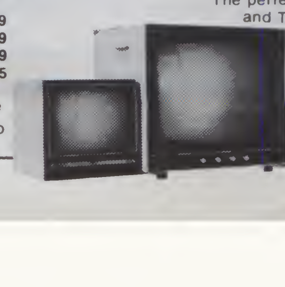
**NEW FROM SANYO —** Four Great Monitors at Low CompuMart Prices.
Sanyo's new line of CRT data display monitors are specifically designed for the display of alpha-numeric or graphic data.

| | |
|---|---|
| 9" Sanyo Monitor | **$159** |
| 12" Sanyo Monitor | **$289** |
| 12" Sanyo Monitor with green screen | **$299** |
| 13" Sanyo Color Display Monitor | **$495** |

Free 6' Cable with purchase of any Sanyo

**EXCLUSIVE from CompuMart!**
Special Offer. Zenith Color Video Monitor for $379!

The perfect monitor for Apple, Atari and Texas Instruments owners.



# Best Price and Delivery

## SUPERBRAIN by Intertec

Self contained computer with dual disks and two RS232C ports. Complete with CP/M 2.2 and BASIC

32K Double Density, List $2995 **$2685**
64K Double Density, List $3345 $2883
64K MiniMicroMart upgraded to Quad Density *SPECIAL $3395*

## VIDEO TERMINALS

*NEW* EMULATOR (Intertec), List $895 $ 749
NEW INTERTUBE III List $895 ONLY $ 749
SOROC 120, List $995 *SPECIAL $ 729*
IQ140, List $1495 *SPECIAL $1149*
PERKIN-ELMER 550, List $997 $ 799
with anti glare screen, $1027 $ 829
HAZELTINE 1410, List $900 $ 749
1420 $ 849
1500, List $1225 $ 879
1510, List $1395 $1089
1520, List $1650 $1389
ADDS R-20, List $995 $ 945
LEAR SIEGLER ADM3A, Assembled $ 849
TELEVIDEO 912C, List $950 Call for
920C, List $1030 prices

## PRINTERS

ANADEX DP-8000 $ 849
DP-9500, List $1650 $1399
DP-9501, List $1650 $1399
PAPER TIGER IDS-440, List $995 $695
w/graphics op., incl. buffer, $1195 $879
NEW IDS PAPERTIGER 460 List 1295 $1149
NEW IDS PAPERTIGER 460G List $1394 $1199
NEC Spinwriters Call for Price
TELETYPE 43 KSR $1087
CENTRONICS
730-1 parallel interface *NEW LOW $649*
737 parallel interface *SUPER VALUE $829*
779 w/Tractor, List $1350 NEW
702 w/Tractor, VFU, List $2480 LOW
703 w/Tractor, VFU, List $2975 PRICES
704 w/Tractor, VFU, List $2350
TI 810 Basic, List $1895 $1695
810 serial & Centronics style parallel interface, List $1940 $1735
810 w/full ASCII (U/LC), Vertical Forms Control, Compressed Print $1895
TI 820 KSR, List $2165 $1895
TI 745 w/full ASCII, List $1695 $1399
COMPRINT 912 w/parallel interface $ 559
912 w/serial interface, List $699 $ 589
AXIOM IMP I $ 699
MICROTEK, List $750 $ 675
OKIDATA Microline 80, List $949 649
Tractor Feed Option $ 99
RS232 Serial Interface $ 89

## NORTH STAR HORIZON®

### HORIZON 1 ASSEMBLED & TESTED

32K, Double Density, List $2695 $2279
32K, Quad Density, List $2995 $2539

### HORIZON 2 ASSEMBLED & TESTED

32K, Double Density, List $3095 $2619
32K, Quad Density, List $3595 $3049
48K, Double Density, List $3590 $3039
48K, Quad Density, List $4090 $3469
64K, Double Density, List $3830 $3239
64K, Quad Density, List $4330 $3669

## FLOPPY DISK SYSTEMS

NORTH STAR MDS-A
Assembled, List $899 *SPECIAL $ 719*
Kit Version, List $799 $ 669
MORROW THINKER TOYS® Discus 2D, List $1199 OUR PRICE $1019*
Discus 2D, dual drive, List $1994 $1694*
Discus 2 + 2, A&T, List $1549 $1319*
Dual Discus 2 + 2, A&T, List $2748 $2335*
*Now includes CP/M® 2.2
MICROMATION Megabox, DD w/8" drives, 1 megabyte, List $2295 $1949
2 megabyte, List $3095 $2629
MICROPOLIS 1041 MacroFloppy®
w/enclosure (no P.S.), List $695 $ 625
1042 MacroFloppy w/case & AC P.S. $ 709
1053 Dual MetaFloppy®, List $1895 $1695

## VIDEO BOARDS

I/O Mapped
SD COMPUTER VDB-8024, kit, List $370 $319 †
Assembled, List $470 $ 399 †
XITEX SCT-100K, Kit ONLY $154.95
SCT 100A Assembled $174.95
SSM VB2 I/O, Kit, List $199 Call
Assembled & Tested, List $269 Call
Memory Mapped
SSM VB1C, 16x64, Kit, List $179
Assembled & Tested, List $242
SSM VB3, 80 Char., 4MHz, Kit, List $485 Call
4 MHz, A&T, List $565 Call
INTERSYSTEMS, 16x64, A&T, List $165 $149

### ESCON CONVERSION FOR IBM SELECTRIC

Complete w/microprocessor controller and power supply. Factory built. User installs solenoid assembly or it can be done at Escon factory at nominal cost.

Parallel (TRS-80, Sorcerer, etc.), $575 $514
RS232 Standard Serial, List $599 534
IEEE-488 (for PET), List $660 584
TRS-80 Cable 25

### CALIFORNIA COMPUTER SYSTEMS

Z80 CPU BOARDS List $299 $269
DISK CONTROLLER 2422 List $399 $359
32 CASE STATIC List $710 $599
64K DYNAMIC BOARD List $699 $589

## CPU BOARDS

(assembled unless noted)

NORTH STAR Z80A (ZPB-A/A), $299 $25
CROMEMCO 4 MHz (ZPU-W), List $395 $33
4 MHz (SCC-W), List $450 $38
INTERSYSTEMS (formerly Ithaca Audio)
new Series II Z-80, 4 MHz, List $395 $34
SSM CB1 8080 A&T List $252
CB1A Kit, List $183
CB2 Z-80 A&T, List $344
CB2 Kit, List $260
DELTA Z-80, with I/O $28
SD SBC-100, List $350 $29
SBC-100 Kit, List $295 $25
SBC-200, List $400 $33
SBC-200 Kit, List $320 $27

## MEMORY BOARDS

32K SD ExpandoRAM Kit
ONLY $289 †
ONLY $189 without RAM chips

NORTH STAR 16K Dynamic RAM Board, A&T (RAM-16-A/A), List $499 $42
16K Kit Version, List $449 SPECIAL $29
32K A&T (RAM-32-A), List $739 $62
32K Kit, List $669 SPECIAL $49
CROMEMCO 16KZ-W, List $495 $41
64KZ-W, List $1795 148
MEASUREMENT SYSTEMS & CONTROLS
(Guaranteed performance, incl. labor/parts 1 yr
DM6400 64K Board w/all 64K, $795 $65
DM4800 with 48K, List $695 $58
DM3200 with 32K, List $595 $50
DMB6400 64K Board w/all 64K $85
DMB4800 with 48K $78
MORROW SuperRAM — all static, all A&T
16K, 4 MHz or 2 MHz, List $349 $29
32K, 4 MHz, List $699 $62
16K Memory Master, List $399 $33
24K Memory Master, List $549 $46
INTERSYSTEMS (formerly Ithaca Audio)
8K Static 2 MHz, A&T, List $165 $14
8K Static 4 MHz, A&T, List $195 $17
16K Static 2 MHz, A&T, List $475 $42
16K Static 4 MHz, A&T, List $495 $44
64K Dynamic, List $995 $89
CALIFORNIA COMPUTER
16K Static, A&T, List $349.95 $25

## FLOPPY DISK CONTROLLER BOARDS

NORTH STAR, DD, Assembled, List $499 $399
MORROW Disk Jockey 1, A&T ($213) $189
Disk Jockey 2D, A&T, List $479 $429
SD Versafloppy 1, Kit, List $250 $212
Versafloppy II, DD Kit, List $350 $297
Versafloppy II, DD, A&T, List $430 $365
DELTA double density A&T ($385) $345
CONDUCTOR, double density A&T $269
INTERSYSTEMS FDC-2, A&T, $495 $439
MICROMATION Doubler, DD, A&T $399
TARBELL Floppy Disk Interface Kit $199
double density, A&T, List $495 $444

### NEW CROMEMCO DOUBLE DENSITY DISK CONTROLLER

List $595 ..... OUR PRICE $505

SHIPPING AND INSURANCE: Add $2.50 for boards, $6 for Selectric Converter or Floppy Disk Drives, $7.50 for Floppy Disk Systems, $15 for Horizon. SHIPPED FREIGHT COLLECT: SuperBrain, Centroni and T.I. printers. Contact us for shipping information on other terminals and printers.
Above prices reflect a 2% cash discount (order prepaid prior to shipment). Add 2% to prices for credit card orders, C.O.D.'s, etc. Prices are subject to change and offers subject to withdrawal without notic

— WRITE FOR FREE CATALOG —

238

# MiniMicroMart, Inc.

1618 James Street, Syracuse NY 13203 (315) 422-4467 TWX 710-541-0431

# LIST OF ADVERTISERS



***This advertiser prefers to be contacted directly.**

kilobaud MICROCOMPUTING

**For further information from our advertisers, please use the Reader Service card located on the last page.**

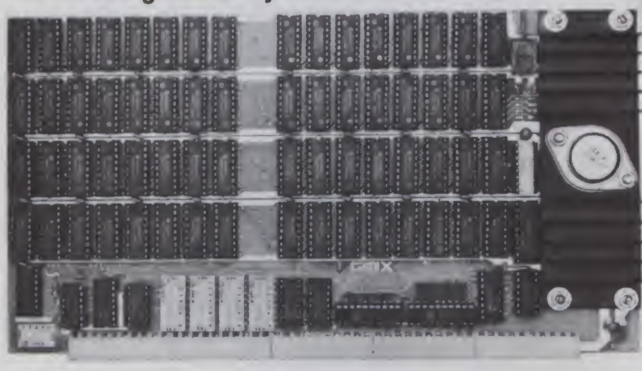
LOOK

# WHAT'S COOKING on the FIFTY BUS

## 32K STATIC RAM BOARDS

**Designed for use with:**

★ **Existing SS50 Systems** ★ **SS50C Extended Address Systems**



- Assembled
- Burned In
- Tested

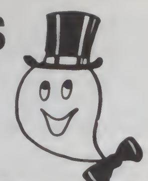
**16K . . . $328.12**
**24K . . . $438.14**
**32K . . . $548.15**

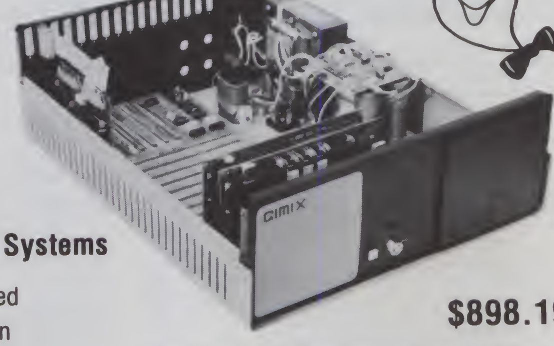
16K and 24K Versions are socketed for 32K and require only additional 2114's for expansion.

### FEATURES:

- Decoding for 4 Extended Address Lines (allows memory decoding up to 1 megabyte)
- DIP-switch to set extended addressing or disable it
- 4 separate 8K blocks, addressable to any 8K boundary by DIP-switch
- Each 8K block may be individually disabled
- Write protect either of two 16K sections
- Low power consumption — uses 2114L low power RAMS
- Fully Socketed
- Gold Bus Connectors
- Guaranteed 2MHz operation

## THE CLASSY CHASSIS





**$898.19**

- 25 amp (5V) ferro-resonant constant voltage power supply,
- Heavy weight aluminum cabinet with 3 position key switch, fan, and provisions for two 5'' disk drives;
- 6800/6809 Mother Board, fifteen 50 pin and eight DIP-switch addressable 30 pin slots (gold plated pins), fully decoded;
- Baud rate generator on I/O section of Mother Board.

## I/O BOARDS

### for the 30 PIN BUS:

| | |
|---|---|
| 1 Port Serial . . . . . . . . . . . . . . . . . . . . (RS 232 or 20MA, current loop) | $ 88.41 |
| 2 Port RS 232 Serial . . . . . . . . . . . . . . | 128.43 |
| 2 Port Parallel . . . . . . . . . . . . . . . . . . . | 88.42 |

### for the 50 PIN BUS:

| | |
|---|---|
| 8 Port RS 232 Serial . . . . . . . . . . . . . . | 288.40 |
| 8 Port RS 232 Serial . . . . . . . . . . . . . . with on board Baud Rate generator. | 318.46 |
| 8 Port Parallel . . . . . . . . . . . . . . . . . . . | 198.45 |

## AND NOW . . . GIMIX OFFERS YOU A Choice of 6800 or 6809 CPU CARDS

**You can order your system to fit your needs or select one of the below featured systems. Please contact the factory for further information and availability.**

Add as much memory as you need using **GIMIX Static RAM Cards** for the utmost in reliability.

**32K 6800 SYSTEM . . . . . . . . . . . . . . . . . . . . . . . . $1,694.59**
Includes: Chassis, 6800 CPU, 32K RAM BOARD, I/O card

**32K 6809 SYSTEM . . . . . . . . . . . . . . . . . . . . . . . . $1,844.69**
Includes: Chassis, 6809 CPU, 32K RAM BOARD, I/O card

**32K 6809 PLUS SYSTEM . . . . . . . . . . . . . . . . . . . . . $1,994.79**
Includes: Chassis, 32K RAM BOARD, I/O Card, and features our 6809 PLUS CPU Card with the Time of Day Clock option with battery back-up installed, as well as the 6840 Timer Package that provides 3 independent 16 bit counters.

This system also allows the following options to be added at additional cost:

- Battery back-up of the 1K RAM by substituting CMOS parts.
- A 9511 or 9512 Arithmetic Processor.
- GIMIX or SWTP Dynamic Address Translators.

### BOTH 6809 SYSTEMS FEATURE OUR NEW TERMINAL BASED GMXBUG 09 SYSTEM MONITOR

GMXBUG 09 includes advanced debugging tools, utility, and memory manipulation routines.

**Both 6809 Systems:**

★ Can be reconfigured to allow use of other system monitors (OS-9 and SBUG-E)

★ Include 1K of Scratchpad RAM on the CPU

★ Allow optional software switching of system monitors.

2MHz 6809's at slight additional cost when they become available.

**EXPORT NOTES:**

For 50Hz 230V C.V. POWER SUPPLY . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Add $30.00
80 x 24 VIDEO BOARDS — Specify Format (No Added Charge)

On Orders under $250.00 for a Single Board, or Chips, please Add $30.00 Handling and we will ship Air Mail Prepaid. On all other orders we will ship via Emery Air Freight Collect, and we will charge no handling. All orders must be prepaid in U.S. Funds. Please note that foreign checks have been taking about eight weeks for collection, so we would advise wiring money or checks drawn on a bank account in the U.S. Our bank is the Continental Illinois National Bank of Chicago, Account #73-32033. Visa or Master Charge also accepted.

### FACTORY PRIME STATIC RAMS

**2114L 450 ns . . $5.90 300 ns . . $6.40 200 ns . . $6.90**
**4044 450 ns . . $5.90 250 ns . . $6.90**
ADD $5.00 HANDLING ON ORDERS UNDER $200.00

Phone, write, or see your dealer for details and prices on our broad range of Boards and Systems for the SS50/SS50C bus and our AC Power Control Products for all computers.

**GIMIX INC.**

✓22

*The Company that delivers Quality Electronic products since 1975.*

**1337 WEST 37th PLACE, CHICAGO, IL 60609**
**(312) 927-5510 • TWX 910-221-4055**

GIMIX® and GHOST® are Registered Trademarks of GIMIX INC.

# READER SERVICE

**Please help us to bring you a better magazine—by answering these questions:**

**I. I am interested enough in a general-interest article to see it in lieu of a technical article.**
- ☐ 1. Yes
- ☐ 2. No

**II. The following types of general interest articles appeal to me most (check two only).**
- ☐ A. Humor
- ☐ B. Interview with users/industry leaders
- ☐ C. Historical
- ☐ D. Essay
- ☐ E. Profile of a business

**III. As a reader of Microcomputing, I consider myself a**
- ☐ 1. Beginner
- ☐ 2. Intermediate
- ☐ 3. Expert

**IV. The articles in Microcomputing are**
- ☐ A. Too simple
- ☐ B. Too complex
- ☐ C. Just right

**V. I want to see more industry news in Microcomputing**
- ☐ 1. Yes
- ☐ 2. No

**VI. The following major computer publication gives me the most usable information (check only one)**
- ☐ A. Kilobaud Microcomputing
- ☐ B. 80 Microcomputing
- ☐ C. Byte
- ☐ D. Interface Age
- ☐ E. Personal Computing
- ☐ F. Creative Computing
- ☐ G. Dr. Dobb's Journal

**VII. I want to see more regular departments in Microcomputing**
- ☐ 1. Yes
- ☐ 2. No

**VIII. I bought this magazine on the newsstand because (answer only if question applies)**
- ☐ A. I was looking specifically for Microcomputing
- ☐ B. The cover caught my eye

**IX. I want to see more of the following kinds of articles in Microcomputing (check two only)**
- ☐ 1. Business
- ☐ 2. Construction
- ☐ 3. Education
- ☐ 4. Game
- ☐ 5. Home application
- ☐ 6. Human interest
- ☐ 7. Programming technique
- ☐ 8. Review
- ☐ 9. Scientific

**X. Is the advertising content of the magazine a primary reason for your buying Kilobaud?**
- ☐ A. Yes
- ☐ B. No

**XI. What type of computer do you own? (Check all that apply)**
- ☐ 1. Apple
- ☐ 2. PET
- ☐ 3. TRS-80
- ☐ 4. Atari
- ☐ 5. Heath
- ☐ 6. TI
- ☐ 7. Other

**XII. If you are not a subscriber, please circle 500.**

Kilobaud MICROCOMPUTING • December 1980

**Reader Service:** Return this card to receive full information on the products advertised in this issue. Refer to the ad. You will find numbers near the logo of each advertiser. Each represents the advertiser's individual Reader Service number. Circle the corresponding numbers on one of the cards on this page, include your name, address & zip, and drop in a mailbox. In 4–6 weeks you'll hear from the advertiser directly.

*This card valid until January 31, 1981*

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6 | 11 | 16 | 21 | 126 | 131 | 136 | 141 | 146 | 251 | 256 | 261 | 266 | 271 | 376 | 381 | 386 | 391 | 396 |
| 2 | 7 | 12 | 17 | 22 | 127 | 132 | 137 | 142 | 147 | 252 | 257 | 262 | 267 | 272 | 377 | 382 | 387 | 392 | 397 |
| 3 | 8 | 13 | 18 | 23 | 128 | 133 | 138 | 143 | 148 | 253 | 258 | 263 | 268 | 273 | 378 | 383 | 388 | 393 | 398 |
| 4 | 9 | 14 | 19 | 24 | 129 | 134 | 139 | 144 | 149 | 254 | 259 | 264 | 269 | 274 | 379 | 384 | 389 | 394 | 399 |
| 5 | 10 | 15 | 20 | 25 | 130 | 135 | 140 | 145 | 150 | 255 | 260 | 265 | 270 | 275 | 380 | 385 | 390 | 395 | 400 |
| 26 | 31 | 36 | 41 | 46 | 151 | 156 | 161 | 166 | 171 | 276 | 281 | 286 | 291 | 296 | 401 | 406 | 411 | 416 | 421 |
| 27 | 32 | 37 | 42 | 47 | 152 | 157 | 162 | 167 | 172 | 277 | 282 | 287 | 292 | 297 | 402 | 407 | 412 | 417 | 422 |
| 28 | 33 | 38 | 43 | 48 | 153 | 158 | 163 | 168 | 173 | 278 | 283 | 288 | 293 | 298 | 403 | 408 | 413 | 418 | 423 |
| 29 | 34 | 39 | 44 | 49 | 154 | 159 | 164 | 169 | 174 | 279 | 284 | 289 | 294 | 299 | 404 | 409 | 414 | 419 | 424 |
| 30 | 35 | 40 | 45 | 50 | 155 | 160 | 165 | 170 | 175 | 280 | 285 | 290 | 295 | 300 | 405 | 410 | 415 | 420 | 425 |
| 51 | 56 | 61 | 66 | 71 | 176 | 181 | 186 | 191 | 196 | 301 | 306 | 311 | 316 | 321 | 426 | 431 | 436 | 441 | 446 |
| 52 | 57 | 62 | 67 | 72 | 177 | 182 | 187 | 192 | 197 | 302 | 307 | 312 | 317 | 322 | 427 | 432 | 437 | 442 | 447 |
| 53 | 58 | 63 | 68 | 73 | 178 | 183 | 188 | 193 | 198 | 303 | 308 | 313 | 318 | 323 | 428 | 433 | 438 | 443 | 448 |
| 54 | 59 | 64 | 69 | 74 | 179 | 184 | 189 | 194 | 199 | 304 | 309 | 314 | 319 | 324 | 429 | 434 | 439 | 444 | 449 |
| 55 | 60 | 65 | 70 | 75 | 180 | 185 | 190 | 195 | 200 | 305 | 310 | 315 | 320 | 325 | 430 | 435 | 440 | 445 | 450 |
| 76 | 81 | 86 | 91 | 96 | 201 | 206 | 211 | 216 | 221 | 326 | 331 | 336 | 341 | 346 | 451 | 456 | 461 | 466 | 471 |
| 77 | 82 | 87 | 92 | 97 | 202 | 207 | 212 | 217 | 222 | 327 | 332 | 337 | 342 | 347 | 452 | 457 | 462 | 467 | 472 |
| 78 | 83 | 88 | 93 | 98 | 203 | 208 | 213 | 218 | 223 | 328 | 333 | 338 | 343 | 348 | 453 | 458 | 463 | 468 | 473 |
| 79 | 84 | 89 | 94 | 99 | 204 | 209 | 214 | 219 | 224 | 329 | 334 | 339 | 344 | 349 | 454 | 459 | 464 | 469 | 474 |
| 80 | 85 | 90 | 95 | 100 | 205 | 210 | 215 | 220 | 225 | 330 | 335 | 340 | 345 | 350 | 455 | 460 | 465 | 470 | 475 |
| 101 | 106 | 111 | 116 | 121 | 226 | 231 | 236 | 241 | 246 | 351 | 356 | 361 | 366 | 371 | 476 | 481 | 486 | 491 | 496 |
| 102 | 107 | 112 | 117 | 122 | 227 | 232 | 237 | 242 | 247 | 352 | 357 | 362 | 367 | 372 | 477 | 482 | 487 | 492 | 497 |
| 103 | 108 | 113 | 118 | 123 | 228 | 233 | 238 | 243 | 248 | 353 | 358 | 363 | 368 | 373 | 478 | 483 | 488 | 493 | 498 |
| 104 | 109 | 114 | 119 | 124 | 229 | 234 | 239 | 244 | 249 | 354 | 359 | 364 | 369 | 374 | 479 | 484 | 489 | 494 | 499 |
| 105 | 110 | 115 | 120 | 125 | 230 | 235 | 240 | 245 | 250 | 355 | 360 | 365 | 370 | 375 | 480 | 485 | 490 | 495 | 500 |

Name ____________________

Address ____________________

City ____________________ State ________ Zip ________

Microcomputing • POB 2741 • Clinton IA 52735

# BOOKS

**Please send me the following Microcomputing products:**

| Qty. | Catalog # | Title | Unit Price | Total |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

Add $1 shipping/handling ________

Total ________

Please allow 4–6 weeks for delivery. No C.O.D.s accepted.

Enclosed $ ________ ☐ Check ☐ M.O.

Bill: ☐ AE ☐ MC ☐ Visa

Card # ____________________ Exp. date ________

Signature ____________________ Interbank # ________

Name ____________________

Address ____________________

City ____________________

State ____________________ Zip ________

12/80

Microcomputing • Mail Order Dept. • Peterborough NH 03458

# SUBSCRIPTION

**MICROCOMPUTING subscribers save $10 off the newsstand price.**

- ☐ New subscription ☐ Renewal
- ☐ 1 year —$25
- ☐ 2 years—$38
- ☐ 3 years—$53

Enclosed $ ________ ☐ Check ☐ M.O.

Bill: ☐ MC ☐ Visa ☐ AE ☐ me

Card # ____________________ Exp. date ________

Signature ____________________ Interbank # ________

Name ____________________

Address ____________________

City ____________ State ____________ Zip ________

Canada—$27, 1 year only, US funds

Other foreign—$35, 1 year only, US funds

30DB9

Microcomputing • POB 997 • Farmingdale NY 11737

kilobaud MICROCOMPUTING

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

# BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 217 CLINTON IA 52735

POSTAGE WILL BE PAID BY ADDRESSEE

kilobaud MICROCOMPUTING T.M.

POB 2741
Clinton IA 52735

---

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

# BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 1024 PETERBOROUGH NH 03458

POSTAGE WILL BE PAID BY ADDRESSEE

kilobaud MICROCOMPUTING T.M.

Subscription Dept.
POB 997
Farmingdale NY 11737

---

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

# BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 1024 PETERBOROUGH NH 03458

POSTAGE WILL BE PAID BY ADDRESSEE

kilobaud MICROCOMPUTING T.M.

Peterborough NH 03458

Att. Mail Order